Guidelines for Inspection and Evaluation of River Management Facilities such as Levees and River Channels

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Ministry of Land, Infrastructure, Transport and Tourism
Water and Disaster Management Bureau
River Environment Division

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Ⅰ. General Remarks

1 Purpose

Deformations of river management facilities such as levees and river channels (hereinafter referred to as “River Management Facilities”) that can affect their functions for flood control, water use, and environmental conservation occur due to various factors, and the timing and location of the deformations are diverse. Therefore, based on the Ministry of Land, Infrastructure, Transport and Tourism's “Technical Standards for River Works Maintenance and Management (River Edition)”, it is necessary to inspect them regularlly or after the action of a large external force such as flooding or an earthquake, to evaluate the functional condition, and to implement necessary measures.

Guidelines for Inspection and Evaluation of River Management Facilities (hereinafter referred to as "the Guidelines") indicates standard contents of (i) preparation of an inspection plan, (ii) evaluation of inspection results, and (iii) methods for detecting and observing abnormalities and changes that serve as the basis for determining appropriate countermeasures such as detailed inspections (including surveys) and repairs. The inspections referred to here are those conducted for the purpose of ensuring the following two flood control functions that rivers should possess.

(1) The river channel must secure the required discharge capacity.

(2) River Management Facilities must ensure their required functions.

Regarding (1), the following circumstances shall be ascertained.

a) Changes in the shape of river channels resulting in a decrease in their cross-section area.

b) Overgrowth of trees which obstruct discharge etc.

Regarding (2), the following circumstances shall be ascertained.

a) Deformations occur in each facility.

b) Changes in river channels, such as riverbed degradation, riverbank erosion, and local scouring, which affect the function and structural stability of facilities.

The basics to ascertain the condition of river channels is to calculate the water level using the results of the latest periodic river longitudinal and cross-sectional diagrams, aerial photogrammetry, riverbed material surveys, vegetation surveys, etc. To ascertain the status of riverbank erosion and scouring, it is also basic to examin the functional and structural stability of the target facility by using periodic river longitudinal and cross-sectional maps.

The Guidelines summarize the inspection and evaluation methods, mainly visual inspection, that should be conducted to monitor (i) the occurrence of deformations and their changes over time by assessing the condition of River Management Facilities, and (ii) the condition of river channel shape and tree growth in areas that require attention as identified by the assessment of the condition based on periodic river cross-sectional maps, etc. and river works such as riverbed excavation that have been conducted in recent years, in order to identify deformations that may affect the discharge capacity and the functional and structural stability of the facilities.

2 Scope of Application

The Guidelines apply to visual inspections (including simple measurements, palpation, percussion inspections, etc.) conducted to detect and observe deformations and changes in River Management Facilities before the flood season, during the typhoon season, and after the flood season. Detailed inspections (including surveys) of river management facilities must be carried out appropriately according to the individual deformation and damage situation with reference to the Ministry of Land, Infrastructure, Transport and Tourism's “Technical Standards for River Works Maintenance and Management (River Edition).” Special inspections for a specific theme, such as simultaneous inspections for the formulation of priority development plans, are out of scope of the Guidelines.

The Guidelines cover the inspection of River Management Facilities (excluding dams), but do not cover mechanical equipments of weirs, sluice gates, sluiceways etc. nor telecommunications facilities. These inspections are carried out in accordance with other stipulated regulataions, etc. [omission].

Inspections of hydrological and hydraulic observation facilities shall be carried out appropriately in accordance with the Hydrological Observation Service Regulations. Post-earthquake inspections will be based on a separate notice, but the Guidelines can be used as a reference for specific inspection items.

Inspections related to the safety of river use will be notified separately and are not subject to the Guidelines.

Permitted structures are basically properly inspected by their installers who have gotten permission from the river administrator (hereinafter referred to as the “installer”). However, if necessary, the installer and the river administrator jointly conduct inspections with reference to the Guidelines.

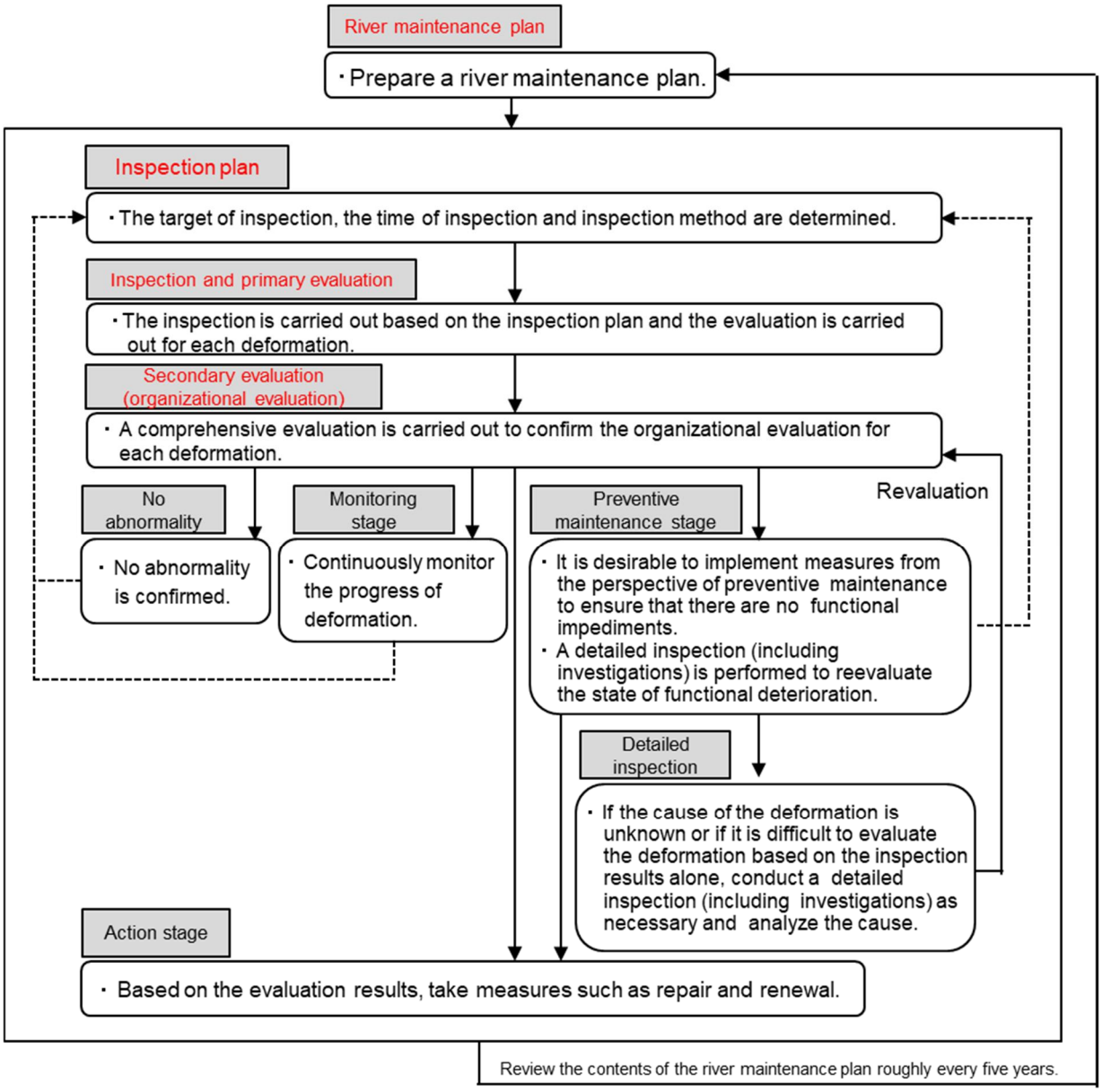


Figure 1.1 Flow of inspection and evaluation of River Management Facilities

3 Inspection Planning

When inspecting River Management Facilities, an inspection plan shall be created in accordance with the following items based on information such as past inspection results, past damage history, repair history, flood control topographic classification maps, and major flood protection locations, etc., with reference to the past inspection process.

3.1 Scope of Inspection

(1) Levees

1) Earthen levee, revetment, steel sheet pile revetment, foot protection work, groin

- Earthen levees, constructed in according to Article 19 of the Order for Structural Standard for River Administration Facilities, etc. (hereinafter referred to as the "Structural Ordinance"), are subject to inspection. A levee in sections affected by storm surges (hereinafter referred to as "storm surge levee") and along the lakeshore, if its structure is the same as that of an earthen levee, will be treated as an earthen levee. In addition, the Class 1 side belts, stipulated in Article 14, Item 1 of the Regulation for Enforcement of the Structural Ordinance, are subject to inspection under the Guidelines.
- Revetment, steel sheet pile revetment, foot protection work, and groin are subject to inspection under the Guidelines if they are attached to or adjacent to the levee (if they are installed on the side of the levee rather than the levee protection line and protected together with the earthen levee).
- Low-water revetment, foot protection work, etc., shall have inspection locations (sections) designated based on recent changes in condition, trends in riverbed degradation, and the location of water impact zones.
- Post-flood inspections (described later) shall establish inspection items for each river section based on the scale and structure of the levee, flood magnitude, and other factors.

2) Storm surge levee, special levee, land locks

- The storm surge levee is so-called covered structure levee in which an earthen levee is three-sided with concrete or similar in consideration of overtopping waves and is classified as an earthen levee in the Guidelines.
- The special levee is intended for two types of levees: free-standing structure, and earthen levee with battlements structure.
- Land locks are also subject to inspection as a similar structure attached to the levee.

(2) River Structures

1) River Structures

- Civil engineering facilities with mechanical equipments such as sluiceway, sluice gate, weirs, ground stills, and drainage stations, are subject to inspection.

2) Levees around structures such as sluiceway

- Levees around structures such as sluiceway, sluice gate, etc., as well as levees around the approaching parts of river crossing structures, shall be inspected separately from the general levee sections.
- The area “around the structure” shall be generally the area where the approach revetment is constructed and shall be set according to the scale of the levee and the structure.

(3) River channel

- River channel is subject to inspection for sediment accumulation, overgrowth of trees, riverbed degradation, riverbank erosion, etc. The locations (sections) to be inspected are set based on recent changes in the river channel and the fluctuation characteristics of the river channel.

3.2 Timing of Inspections

(1) Periodic inspections

- Periodic inspections shall be carried out before the flood season and during the typhoon season. Their specific timing will be set for each river. The targets of the typhoon season inspection are the earthen levee and the levee around structures such as sluiceway.
- Inspection timing shall be set with prior weed removal as a prerequisite to ensure the condition of the levee can be inspected.
- In areas where snowmelt runoff occurs, an appropriate time is set for each river, considering the situation of snowmelt runoff, etc.
- The typhoon season refers to the time when typhoons occur frequently in the autumn, and its specific period is set for each region.

(2) Post-flood inspections

- Post-flood inspections shall be conducted when flooding exceeds the pre-set flood scale for each river. The flood scale setting shall be based on flooding exceeding the flood warning level (warning water level) (when a significant storm surge occurs in the storm surge section), while also considering flood scales where changes that could potentially impact flood control functions are anticipated to begin occurring, based on river channel characteristics and historical flood damage records.
- The status during flooding is assessed through river patrols.

3.3 Inspection method

(1) Means

- Inspections shall be carried out by visual inspection or other appropriate methods.
- Other appropriate methods are inspection methods using a technology that is judged to be able to grasp the condition at the same or higher level than visual inspection. (Hereinafter, they are treated as "visual" inspection and "visual inspection.”)
- When conducting inspections and river patrols, etc., based on the improvement of existing

technology and the progress of new technologies in recent years, efforts shall be made for more efficient and advanced on-site work by proactively utilizing the technologies listed in the "River Inspection Technology Catalog[1]".

- Inspections are based on photographing of each deformation: a panoramic view photo that can confirm its overall scale and a close-up view that can confirm its degree.
- For abnormalities identified during visual inspections that may progress, those evaluable by measurement shall undergo fixed-point observation through measurement.
- Detailed inspections, conducted based on the results of visual inspections and fixed-point observations (including observations), shall be carried out according to the "Guidelines for Detailed Inspection for Levees Around Structures such as Sluiceways."
- The inspection results are basically recorded as a database. RiMaDIS[2] terminals are basically used for the national management sections.

(2) Implementing System

- To secure safety, inspections should not be carried out by one person, and a team of two or more people will be formed.
- Low-water revetments (sheet pile revetments) etc. that can only be visible from the water surface will be inspected from ships if necessary.

4 Evaluation method

4.1 Evaluation Procedure

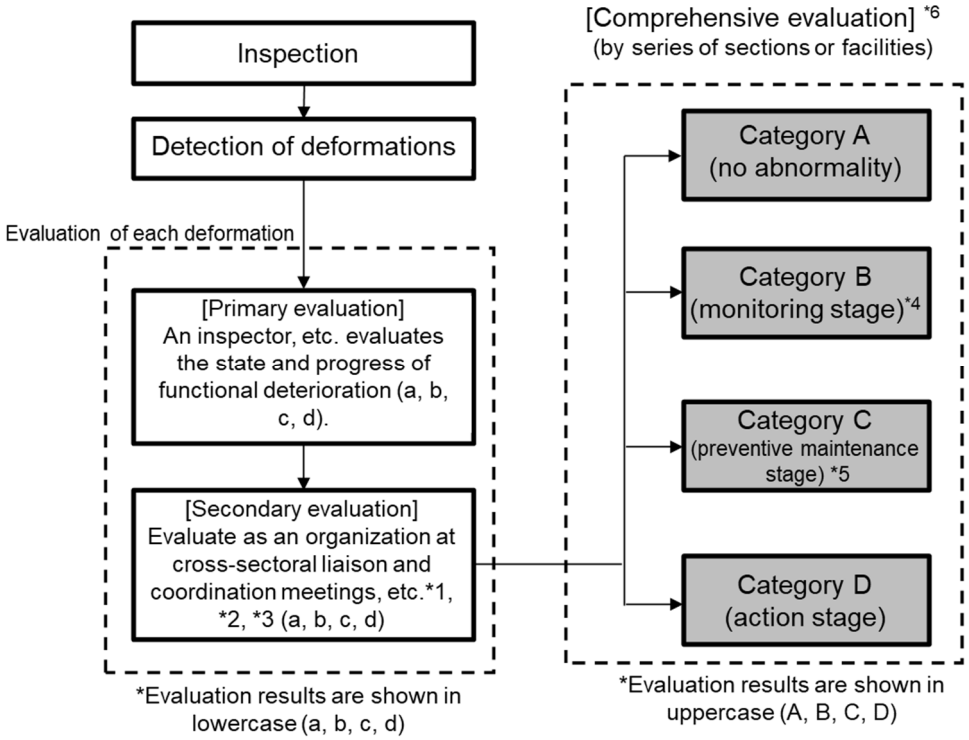
- Since there are many invisible parts of river management facilities, and since they perform their functions in an integrated manner with levee body and foundation ground, it is not easy to evaluate the state of function by visual inspection. For this reason, we will focus on "deformations" that may affect the function of the facility in a visible way and evaluate each deformation part.
- The primary evaluation evaluates the state of functional deterioration and progression by on-site visual inspection.
- The secondary evaluation shall be conducted organizationally for each deformation part: primary revaluation results and deformation deemed difficult to determine by the primary evaluation. This evaluation shall be perfomed at cross-functional liaison and coordination meetings involving relevant departments within the river office, based on existing documentation and other materials.
- For the secondary evaluation, if necessary, the river office shall receive advice from academic experts and/or technical assistance from technical consultation desks of the River and Sabo Conservation Technical Support Team in each regional development bureau or the National Institute for Land and Infrastructure Management.
- Furthermore, the comprehensive evaluation shall be carried out with a series of levees and a river

[1] https://www.mlit.go.jp/river/shishin_guideline/kasen/tenkengijutsu/kasentenken.html

[2] RiMaDIS (River Management Data Intelligent System) is a database system that supports river maintenance and management operations and centrally manages the results of river patrols and inspections, as well as the repair history of river management facilities.

structure such as sluiceway as a unit based on the evaluation results for each deformation part.

- In the comprehensive evaluation, measures shall be taken to eliminate differences in the evaluation results by confirming the results of the previous evaluation of the "series of sections" or "facilities" recorded in the database and the reasons for the evaluation.



*1. Based on the previous data, etc. (flood control landform classification map, disaster history, geological information, embankment history, periodic cross-sectional survey map, seepage flow analysis results, design data, etc.)

*2. Conduct a detailed inspection (including investigations) of any deformations that are invisible or of unknown cause as necessary and take into account its inspection results.

*3. If necessary, receive advice from academic experts, specialists, etc.

*4. Include deformations that require minor repair

*5. If necessary, conduct a detailed inspection (including surveys).

*6. This flow chart does not cover the inspection and evaluation of river channels.

Figure 1.2 Evaluation procedure*6

4.2 Evaluation of Function

- The evaluation of the inspection results should focus on the required functions and degraded status of each facility listed in Table 1.2 and Table 1.3.

Table 1. 2 Required Functions and Degraded Status of Each Facility (Levees)

<table>
<tr><th>Facility Classification</th><th>Function</th><th>Degraded status</th><th colspan="2">Deformation</th></tr>
<tr><td rowspan="12">Earthen levee</td><td rowspan="12">- Overflow prevention
- Seepage resistance
- Anti-erosion</td><td rowspan="12">- Subsidence
- Slip destruction
- Occurrence of piping
- Erosion
etc.</td><td colspan="2">[1] Crack</td></tr>
<tr><td colspan="2">[2] Cave-ins and uneven terrain</td></tr>
<tr><td colspan="2">[3] Slope Collapse</td></tr>
<tr><td colspan="2">[4] Subsidence</td></tr>
<tr><td colspan="2">[5] Deformation of levee foot protector</td></tr>
<tr><td colspan="2">[6] Protrusion</td></tr>
<tr><td colspan="2">[7] Steepening Slope</td></tr>
<tr><td colspan="2">[8] Holes for small animals such as moles</td></tr>
<tr><td colspan="2">[9] Poor drainage</td></tr>
<tr><td colspan="2">[10] Tree invasion</td></tr>
<tr><td colspan="2">[11] Erosion and vegetation abnormalities</td></tr>
<tr><td colspan="2">[12] Water leakage and sand boil</td></tr>
<tr><td rowspan="8">Revetment (Levee revetment, high-water revetment, low-water revetment[*1])</td><td rowspan="8">- Anti-erosion
- Seepage resistance</td><td rowspan="8">- Damage to revetment
- Occurrence of water leakage
etc.</td><td rowspan="2">[13] Damage to revetments and coverings</td><td>Revetments and coverings other than iron wire basket revetment</td></tr>
<tr><td>Iron wire basket revetment</td></tr>
<tr><td>[14] Protrusion</td><td>Revetment</td></tr>
<tr><td rowspan="2">[15] Scouring of the foundation</td><td>With foot protection work</td></tr>
<tr><td>Without foot protection work</td></tr>
<tr><td rowspan="2">[16] Edge erosion</td><td>Revetments other than articulated concrete mattress</td></tr>
<tr><td>Articulated concrete mattress</td></tr>
<tr><td rowspan="2">Special levees and storm surge levees</td><td rowspan="2">- Anti-erosion
- Seepage resistance
- Overflow prevention
- Soil retaining</td><td rowspan="2">- Damage to the main body
etc.</td><td colspan="2">[17] Damage to the main body[*2]</td></tr>
<tr><td colspan="2">[18] Joint deformation, break[*3]</td></tr>
<tr><td>Steel sheet pile</td><td>- Anti-erosion
- Soil retaining</td><td>- Tilting of steel sheet piles and cap</td><td colspan="2">[19] Deformation, protrusion and breakage of steel sheet piles</td></tr>
</table>

revetment		concrete - Suction (or water leakage) from steel sheet pile revetment etc.	[20] Corrosion of steel sheet piles (rust, holes, reduced wall thickness)
			[21] Opening and missing steel sheet pile joints
			[22] Subsidence and cave-in of the ground behind
			[23] Deformation and damage of cap concrete

*1 Low-water revetments are not subject to evaluation in general, but those that are installed on the side of the levee rather than the levee protection line and are protected together with the earthen levee are subject to evaluation.

*2 The main body of a special lavee or storm surge levee corresponds to the battlements of the special levee, the main body of the freestanding structure, and the wave return work of the storm surge levee. Since the cover work has a structure like that of a revetment, it is evaluated as the revetment.

*3 The deformation or break of the joint in [18] is the joint with the main body of the special levee and does not include the joint between the revetment and the partition wall.

Table 1. 3 Required Functions and Degraded Status of Each Facility (River Structures)

Type of work	Function	Degraded status	Deformation
Sluiceway	- Water shut-off (backflow prevention) - Water intake and drainage	- Leakage from surrounding levees - Damage to surrounding levees - Failure to open and close the gate - Leakage of the box - Insufficient discharge capacity (reduction of water flow cross-section) etc.	[1] Cracks and loosening of surrounding levees, cracks in the approach revetments
			[2] Cavitation under the box, etc.
			[3] Damage to boxes, etc.
			[4] Joint deformation, breaking
			[5] Deformation or damage to gateposts, etc.
			[6] Sediment accumulation in the box
			[7] Excessive subsidence of the box
Sluice gate	- Drainage - Water shut-off (backflow prevention) - Water transportation	- Leakage from surrounding levees - Damage to surrounding levees - Failure to open and close the gate - Leaks in waterways - Insufficient discharge capacity (reduction of water flow cross-section) etc.	[1] Cracks and loosening of surrounding levees, cracks in the approach revetments
			[2] Deformation or damage of weir columns, floor slabs, battlements, wing walls, and apron
			[3] Joint deformation, breaking
			[4] Deformation or damage to gateposts, etc.
			[5] Sediment accumulation in waterways

Weir	- Water flow control (flood flow, segregation, water intake) - Sediment discharge - Water transport - Fishway	- Destabilization of riverbeds - Failure to open and close the gate - Insufficient discharge capacity (reduction of water flow cross-section) - Partition dysfunction etc.	[1] Deformation and damage of apron and revetment works, etc., scouring of riverbeds upstream and downstream
			[2] Deformation and damage of floor slabs, weir columns, gateposts, etc.
			[3] Deformation and damage of the fishway
			[4] Sediment accumulation in the river channel (around the gate), upstream of the main body, inside the lock, and in the fishway

* Among the facilities listed in Article 7-2 of the Ordinance for Enforcement of the River Act, the deformation of locks and other facilities shall be evaluated based on the structure and function of the facility.

4.3 Evaluation of Each Deformation Part

- The evaluation of the inspection results for each deformed part is basically carried out according to the classification in Table 1.4.
- The evaluation of each deformation is expressed in lowercase letters (a, b, c, d).

Table 1. 4 Classification of Inspection Results Evaluation for Each Deformation Part

Category		State	Deformation confirmed	Function impediment
a	No abnormality	・ A sound state in which no or slight visible deformation is confirmed but there is no hindrance to the functions of river management facilities.	No	No
b	Monitoring stage	・ A state in which there is no hindrance to the functions of river management facilities, but a deformation that may progress has been confirmed and it is necessary to monitor the progress (including the case where minor repair is required).	Yes	No
c	Preventive maintenance stage	・ A state in which the functions of river management facilities are not hindered but a deformation is progressive, and it is desirable to implement measures from the viewpoint of preventive maintenance. ・ A state in which it is necessary to re-evaluate the functional deterioration of river management facilities through a detailed inspection (including surveys).	Yes	No
d	Action stage	・ A state in which the functions of river management facilities are impaired, and measures such as repair or renewal are necessary. ・ A deformation that is determined to have caused a malfunction through detailed inspections (including surveys) and requires corrective action.	Yes	Yes

- There are four levels of evaluation of inspection results for each deformation part: (a) No abnormality, (b) Monitoring stage, (c) Preventive maintenance stage, and (d) Action stage.
- In the (b) Monitoring stage, minor deformations will be repaired as necessary.
- In the (c) Preventive maintenance stage, the progress of the deformation, the scale of the damage,

and the economic feasibility are comprehensively assessed, and appropriate measures are systematically implemented. If the cause of the deformation is unknown, or if it is difficult to evaluate only the results of visual inspection, countermeasure studies and re-evaluation of each deformation are conducted by collecting advice from academic experts and specialists etc. and/or conducting detailed inspections (including surveys) if necessary.

- In the (d) Action stage, the functions of river management facilities are evaluated as hinderd and measures such as repairs shall be implemented promptly. But if measures such as repairs cannot be taken in time by the next flooding season, emergency measures (including temporary measures) will be implemented.

4.4 Post-Measure Evaluation

- When corrective measures such as repairs restoration are implemented for abnormalities that impair functionality or for abnormalities where preventive maintenance is desirable, a re-evaluation shall be carried out according to the status of the measures ("full restoration" or "emergency restoration").
- "Full restoration" will be restored to a healthy state with no hindrance to function, and will be rated “a”, and follow-up observation will be conducted as necessary.
- "Emergency restoration" is a temporary functional restoration in preparation for coming floods, and since there is a possibility that deformation may progress, it will eventually be necessary to restore the facility to its original function, and continuous monitoring is required, so it will be rated “b”.

Table: Evaluation Classification after Countermeasures

Recovery Status	State	Category		Deformation confirmed	Function impediment
Full restoration	Restore to a healthy state with no hindrance to function	a	No abnormality	No	No
Emergency restoration	Temporary functional restoration in preparation for floods, and there is a possibility that it may progress, and it will be necessary to fully restore it.	b	Monitoring stage	Yes	No

4.5 Comprehensive Evaluation

- The comprehensive evaluation of the inspection results for each section or facility is basically carried out according to the categories in Table 1.5.
- The results of the comprehensive evaluation are expressed in uppercase letters (A, B, C, D).
- The comprehensive evaluation shall be conducted based on the evaluation of the results of inspections of each deformation that has occurred in river management facilities such as levees,

focusing on the functional state that each facility should have, and based on the results, it shall be carried out for the purpose of grasping the overall picture of the soundness of river management facilities such as levees in each river.

- For prompt and systematic implementation of necessary measures, a comprehensive evaluation should be carried out every year just after completion of all evaluations of each deformation in the relevant fiscal year.
- Since levees have the characteristics that their local safety determines the safety of their entire section, the unit for a comprehensive evaluation of levees is based on a “series of sections” set in consideration of flood brocks, confluence points of tributaries, and mountainous areas. In rivers where the "series of sections" set above becomes long due to the vastness of the flood blocks, etc., the "series of sections" shall be set again after considering the conditions of major bridges and levees.
- In the case of river structures, civil engineering facilities, mechanical equipment, and telecommunications facilities work together to perform their functions, so the unit for conducting a comprehensive evaluation is based on "facilities" such as sluiceways and sluice gates.
- For small and medium-sized rivers which are difficult to clearly divide the flood blocks, a "river" can be used as a unit to perform a comprehensive evaluation of the levees according to the condition of the river.
- The complehensive evaluation must be made by considering existing data such as investigation results regarding deformations, the status of emergency countermeasures taken after deformation confirmation, and other relevant factors, while also taking into account detailed inspections (including surveys) and future countermeasure construction work. Therefore, it shall be conducted through cross-functional liaison and coordination meetings involving relevant departments within the river office to ensure systematic verification.
- If necessary, the river office shall receive advice from academic experts and/or technical assistance from technical consultation desks of the River and Sabo Conservation Technical Support Team in each regional development bureau or the National Institute for Land and Infrastructure Management.

Table 1. 5 Comprehensive Evaluation Categories

Category		State	Deformation confirmed	Function impediment
A	No abnormality	・ A sound state in which no or slight visible deformation is confirmed but there is no hindrance to the functions of river management facilities.	Yes	No
B	Monitoring stage	・ A state in which there is no hindrance to the functions of river management facilities, but a deformation that may progress has been	Yes	No

		confirmed and it is necessary to monitor the progress (including the case where minor repair is required).		
C	Preventive Maintenance stage	・ A state in which the functions of river management facilities are not hindered but a deformation is progressive, and it is desirable to implement measures from the viewpoint of preventive maintenance. ・ A state in which it is necessary to re-evaluate the functional deterioration of river management facilities through a detailed inspection (including surveys).	And	without
D	Action stage	・ A state in which the functions of river management facilities are impaired, and measures such as repair or renewal are necessary. ・ A deformation that is determined to have caused a malfunction through detailed inspections (including surveys) and requires corrective action.	And	And

4.6 Evaluation of River Structure Facilities

・ River structures with machinery and telecommunications facilities (ex. gutter gates) shall be comprehensively evaluated based on the evaluation of the inspection results of mechanical equipment and telecommunication facilities in addition to civil engineering facilities.

5 Concept of Countermeasures

(1) Concept of countermeasures in the evaluation of each deformation part

- In the "monitoring stage," the functions of river management facilities have not been hindered, but since deformations that may progress have been confirmed, the inspection plan shall be reviewed if necessary and the facilities shall be continuously monitored (including minor repairs).
- In the "preventive maintenance stage," although the functions of river management facilities are not hindered, measures are desirable to be implemented from the perspective of preventive maintenance and appropriate measures shall be systematically implemented.
- In the "action stage," since the functions of river management facilities are hindered, appropriate measures such as repair or renewal shall be promptly implemented without waiting for a comprehensive evaluation.

(2) Concept of countermeasures in the comprehensive evaluation

- Among the river management facilities that are evaluated as "preventive maintenance stage" in the comprehensive evaluation, river management facilities that require large-scale repair or renewal shall be efficiently and systematically repaired or renewed.
- In the "action stage," since the functions of river management facilities are hindered, appropriate measures such as repair or renewal shall be promptly implemented.

6 Recording and Utilization

(1) Recording

- The results of inspection and evaluation are basically recorded as a database. For the national management sections, RiMaDIS is basically used as the database.
- Deformations that require measures such as repair (restoration) may occur repeatedly, and since it is important information for management, an evaluation record before the measure shall be kept in the River Record, etc.

(2) Utilization of inspection and evaluation results

- The results of inspections and evaluations will be used for comprehensive evaluations and consideration of countermeasures at cross-sectional liaison and coordination meetings, etc. Factors will be analyzed for the occurrence of multiple deformations, repetition of deformations, and significant changes in progression, etc., and will be used to examine the necessity of drastic renovation and renewal of structures.
- Signs and traces of the sucking out of levee bodies, such as the occurrence of cavities and cave-ins, leaks, and sand boils, are indicative of the damage itself. In such cases, prompt measures such as detailed inspections (including survey) should be taken as soon as possible.
- For river structures with machinery and equipment, efforts shall be made to share information with periodic inspections of machinery and equipment.
- Depending on the results of the inspection, excavation, tree cutting, review, etc. will be considered,

and the river maintenance plan will be revised as necessary.

- Deformed areas will be treated the same as major flood protection locations, which require attention in case of flooding.
- They will be used as a basic document for the preparation of the inspection plan for the next fiscal year.

Ⅱ. Inspection and Evaluation of Levees

1 Purpose

Levees have maintained their safety through repeated reinforcement measures such as raising their height and widening their width, adapting to changes caused by floods and other forces. Therefore, it is particularly important to grasp the condition by inspection for maintaining the function of levees.

Regular levee inspections should be carried out twice a year, one before the flood season and the other during the typhoon season.

In the event of a flood, new deformation may occur in the levee due to water flow and rainfall. Therefore, in addition to regular inspections, if there is a flood that exceeds the set scale in each river, an inspection will be carried out after the flood.

Levees are also deformed daily due to natural effects such as rainfall and dryness, human effects such as river use and vehicle traffic, and the intrusion of plant roots and the formation of animal habitat holes. The daily condition of levees should be grasped through river patrols during normal times.

Although it is necessary to grasp the deformation of the levees such as cracks, ruts, bare ground, and wet condition by inspection, the Guidelines stipulate standard inspection items based on experience. It is also important to enhance the technical aspects of levee inspections by accumulating experience in grasping the condition, analyzing and evaluating them, and repeating countermeasures.

In addition to visual inspections, detailed inspections (including surveys) should also be considered according to the individual functions of the levees. A levee construction project including its excavation provides a valuable opportunity to grasp the constituent materials and history of its body. Its cross-section survey shall be conducted in accordance with the "Survey Manual for River Levee Excavation (March 23, River Bureau Flood Control Division)".

Free-standing structural levees and concrete-covered storm surge levees need to be inspected as concrete structures. The levee sections covered with concrete or similar materials are difficult to assess for seepage or voiding based on appearance alone; therefore, attention must be paid to any precursor phenomena.

2 Inspection Items

A list of standard inspection items is shown in Tables 2.1 and 2.2.

The pre-flood inspection basically covers all items, and the typhoon season inspection basically covers only the earthen levee.

The post-flood inspection is basically carried out for all items except land locks, and for deformations that may occur due to flowing water and rainfall.

Table 2.1 Standard Inspection Items for Levees (Part 1)

Item	Area	Inspection items
Earthen levees	Slope・Banquette	Are there any cracks, cave-ins, protrusions, slope collapses, steeping slopes, erosion, etc. (or have they worsened since the last inspection)?
		Are there any abnormalities in the condition of the levee vegetation and topsoil, such as peeling of the squad, or is it more advanced than at the time of the last inspection?
		Are there any inverted slopes or locally low areas of banquettes that are causing problems with storm drainage?
		Is there any unevenness?
		Are there any areas that seem to be muddy?
		Is there a cavity in the levee due to the concentration of holes of small animals such as moles?
		Is there a cave-in in the place where the holes of small animals such as moles were concentrated?
		Has there been any tree invasion or spread?
		Is there any scouring or erosion due to the concentration of road surface drainage at the slope and staircase attachment part?
	Crest	Are there any deformations such as cracks, cave-ins, unevenness, or subsidence at the crest and shoulder of the levee (or have they worsened since the last inspection)?
		Is there any erosion in the crest shoulder (or have they worsened since the last inspection)?
	Foot of back slope	Is there any infiltration due to poor drainage near the levee?
		Is there a risk that the levee soil near its foot will become soft and fluid?
		Is there a place where the squeezed water is always in an infiltrated state?
		Are there any water leaks or sand boils near the foot of back slope?
		Is there any deformation of the levee protector (or have they worsened since the last inspection)?
		Are there clusters of vegetation species that prefer wetness?
		Is there any clogging of the drain or the drainage of turbid water?
	Levee waterway	Is there any leakage or sand boils from the seams of the levee waterway?
		Is there any blockage in the levee waterway?
Revetment	Levee revetment, High-water revetment, Low-water revetment	Are there any deformations such as joints, cracks, or breakage on the revetment?
		In areas where the surface of the levee revetment and high-water revetment is covered as a measure against infiltration, is there any exposure or break of the water-blocking sheet?
		Is there any scouring or erosion of the revetment and its edges?
		Has the concrete or steel structure deteriorated or corroded?
		Has stacked structure such as concrete blocks and discarded stones been deformed by subsidence, collapse, etc.?
		Is there any protrusion in the stacking structure of concrete blocks, etc.?
		Is there any riverbed degradation or local scouring occurring on the low-water revetment that could lead to concerns such as subsidence, collapse, or cave-ins?
Steel sheet pile revetment	Steel sheet pile	Has the concrete or steel structure deteriorated or corroded?
		Are there any uneven settlement or tilting in the concrete or steel structure, or are there any gaps or suction at the joints with the soil structure?
	Ground behind	Are there any subsidence or cave-ins in the ground behind the revetment?
	Cap concrete	Has the concrete or steel structure deteriorated or corroded?
		Are there any height differences, misalignments, or openings in the concrete joints and construction joints of the cap concrete?
Foot protection work, groin	Root protection work・Groin	Is there any deformation of the root protection work (or have they worsened since the last inspection)?
		Is there any deformation of the groin (or have they worsened since the last inspection)?
		Is there any riverbed degradation or local scouring, which may be deformations such as subsidence, collapse, and depression in the root protection work and groin?
		Are there any deformations, damage, or corrosion on the wooden components that impair the function of the facility?

* If the typhoon season and the inspection period after flooding overlap, both can be carried out together.

Table 2.2 Standard Inspection Items for Levees (Part 2)

Item	Area		Inspection items
Storm surge levees (covered structure levee)	Wave breaker work (and body work of breast wall)		Are there any cracks?
			Are there any peeling, flaking, or defects?
			Is there rust juice, exposed rebar, etc.?
			Are there any height differences, misalignments, or openings in the span joints and construction joints?
	Crest covering		Is there any subsidence or cave-in?
			Is there any overgrowth of vegetation?
			Are there any cracks?
			Are there any height differences, misalignments, or openings in the span joints and construction joints?
			Are there any peeling, flaking, or defects?
	Front and back covering		Are there any cracks?
			Is there any subsidence or cave-in?
			Are there any height differences, misalignments, or openings in the span joints and construction joints?
			Are there any traces of water leakage or eruption?
			Is there any overgrowth of vegetation?
			Are there any peeling, flaking, or defects?
			Is there rust juice, exposed rebar, etc.?
	Drainage		Are there any deformations such as height differences, misalignments, openings, or water leaks in the joints? Also, have they worsened from the past?
	Parapet work, foot protection work		Are there any moving or scattering blocks?
			Is there any subsidence?
			Are there any breaks, cracks, or damage to the blocks?
Special levee	Free-standing structural levee	Body, wave breaker work	Are there any cracks?
			Are there any peeling, flaking, or defects?
			Is there rust juice, exposed reber, etc.?
			Are there any height differences, misalignments, or openings in the span joints and construction joints?
		Drainage	Are there height differences, misalignments, or openings in the joints?
		Parapet work, foot protection work	Are there any moving or scattering blocks?
			Is there any subsidence?
			Are there any breaks, cracks, or damage to the blocks?
	Buttress structural levee	Buttress	Is there any subsidence or cave-in?
			Are ther any cracks?
			Are there any peeling, flaking, or defects?
			Is ther rust juice, exposed reber, etc.?
			Are ther any height differences, misalignments, or openings in the span joints and construction joints?
Land lock			Are ther any height differences, misalignments, or joint openings with the crest of the adjuscent levees?
			Is there any tilt or deflection of the door body?
			Is there rust on the door body or wheels?
			Is there any foreign matter such as debris between the door body and the levees?

* If the typhoon season and the inspection period after flooding overlap, both can be carried out together.

3 Earthen Levees

3.1 Inspection items

Unlike concrete structures, earthen levees are also damaged by the effects of flooding (flowing water) and rainwater, vegetation, and animal activities. The main causes of levee failure are overflow, infiltration, and erosion, but not only the action of flowing water during flooding, but also the concentration of rainwater flow on the shoulder and slope due to rainfall during flooding causes slope failure, and slippage caused by rainwater seepage into the levees is also a factor of levee failure during flooding.

In newly constructed levees and widening levees, the possibility of deformation due to consolidation is higher than that of existing levees. In addition, if there is a crack, depression, or protrusion in the vicinity, there is a possibility that suction has occurred, so it is necessary not only to evaluate each inspection item individually, but also to consider the necessity of a detailed investigation.

Table 2.3 Inspection items for earthen levees

Area	Inspection Items before the flood season and during the typhoon season
Slope・Banquette	・ Are there any cracks, cave-ins, protrusions, slope collapses, steeping slopes, erosion, etc.? ・ Are there any abnormalities in the condition of the levee vegetation and topsoil, such as peeling of the squad? ・ Are there any inverted slopes or locally low areas of banquettes that are causing problems with storm drainage? ・ Is there any unevenness on slope or banquette? ・ Is there a cavity in the levee due to the concentration of holes of small animals such as moles? ・ Has there been any tree invasion or spread? ・ Is there any scouring or erosion due to the concentration of road surface drainage at the slope and staircase attachment part?
Crest	・ Are there any deformations such as cracks, cave-ins, unevenness, or subsidence at the crest and shoulder of the levee? ・ Is there any erosion in the crest shoulder?
Foot of back slope	・ Is there any infiltration due to poor drainage near the levee? ・ Is there a place where the squeezed water is always in an infiltrated state? ・ Are there any water leaks or sand boils near the foot of back slope? ・ Is there any deformation of the levee protector? ・ Are there clusters of vegetation species that prefer wetness? ・ Is there any clogging of the drain or the drainage of turbid water?
Levee waterway	・ Is there any leakage or sand boils from the seams of the levee waterway? ・ Is there any blockage in the levee waterway?

3.2 Evaluation items

The criteria for evaluating inspection results at each deformation of an earthen levee shall be established for each river based on its specific characteristics. For reference, Table 2.4 shows the established evaluation criteria, which were set based on existing literature and the actual maintenance practices of river management facilities to date.

Table 2.4 Criteria for Evaluating Inspection Results of Earthen Levees

Type of deformation / Category		Evaluation of Each Deformation Part*1												Comprehensive Evaluation	
		[1] Crack	[2] Cave-ins and uneven terrain	[3] Slope Collapse	[4] Subsidence*2	[5] Deformation of levee foot protector*3	[6] Protrusion	[7] Steepening Slope*4	[8] Holes for small animals such as moles	[9] Poor drainage	[10] Tree invasion	[11] Erosion and vegetation abnormalities	[12] Water leakage and sand boil	Category	Condition
a	No abnormality	●No abnormality	●No abnormality	●No abnormality	●No abnormality	●No abnormality	●No abnormality	●No abnormality	●No abnormality	●No abnormality	●No abnormality	●No abnormality	●No abnormality	A	●No abnormality
b	Monitoring stage	●A crack has been confirmed, but there is no hindrance to the function of levees. ●Including minor repairs.	●An uneven terrain has been confirmed, but there is no hindrance to the function of levees. ●Including minor repairs.	●A slope collapse has been confirmed, but there is no hindrance to the function of levees. ●Including minor repairs.	●A subsidence has been confirmed, but there is no hindrance to the function of levees. ●Including minor repairs.	●A deformation of levee foot protector has been confirmed, but there is no hindrance to the function of levees. ●Including minor repairs.	●Protrusion has been confirmed, but there is no hindrance to the function of levees.	●Steepening slope has been confirmed, but there is no hindrance to the function of levees.	●Holes for small animals such as moles have been confirmed.	●Poor drainage can be observed during or after flooding, or after rainfall. ●Including minor repairs.	●Short trees, which can be easily cut down with tools such as brush cutters, can be identified.	●Bare ground has been created, but there is no hindrance to the function of levees. ●Vegetation causing bare ground (Japanese knotweed, etc.) can be identified.	●Wetland plants are growing at the toe of the back slope, but if the cause of wetland formation is something other than river water permeating the levee body or foundation soil.	B	●There is no hindrance to the function of levees, but a potentially progressive abnormality has been identified and requires monitoring of its course.
c	Preventive maintenance stage	Since levees can undergo rapid deterioration due to flooding and other factors, making degradation prediction difficult, items from [1] to [7] shall not be generally assigned a “c” rating. However, considering the practice of reparing deformations of a certain scale or larger to date, detailed inspections (including survey) shall be conducted as necessary when the cause of deformation is unknown or when evaluation based solely on visual inspection results is difficult.							●Holes for small animals such as moles are likely to cause the surrounding area to collapse. ●In case of molehills, walking around the mound causes feet to sink deeply, etc.	●Remains moist even several days after rainfall. ●Seepage water from the levee, etc.	●Treees are encroaching, but no changes in the levee’s shape are observed. But there is a risk that trees may grow and impair the levee’s functionality.	●Erosion has been confirmed on the levee body. ●Abnormalities in the vegetation on the levee, such as peeling (easily repairable). ● If both abnormalities in the levee vegetation and levee body loosening are confirmed, conduct a detailed inspection (including surveys) and take necessary measures.	●The toe of the back slope or surface of the back slope becomes waterlogged, showing signs of wetland vegetation growth, but its cause is unknown, requiring detailed inspection (including surveys).	C	●There is no hindrance to the function of levees, but a progressive condition is recognized which should be addressed from a preventive maintenance perspective. ●Re-evaluation of the hindrance of the levee’s functionality is required by detailed inspection (including survey).
d	Action stage	●The function of levees is impaired by a crack. ●A crack has reached lower than the high-water level.	●The function of levees is impaired by cave-ins. ●Cave-ins and uneven terrain have reached lower than the high-water level. Water paths have been formed, etc.	●The function of levees is impaired by a slope collapse.	●The function of levees is impaired by a subsidence.	●The function of levee foot protector is impaired. ●Significant deformation and displacement which might have been caused by back slope slide etc.	●Protrusion has also caused other complex deformations such as cracks and slope collapse, impairing the levee’s functionality.	●The function of levees is impaired by cracks and slope collapses caused by steepening slope.	● Deformations from [1] to [4] have appeared due to holes made by small animals such as moles and foxes, causing impairment to the levee’s functionality. Or holes may be dug deep into the levee body, potentially impairing its functionality.	●Deformations from [1] to [7] have appeared due to poor drainage, causing impairment to the levee’s functionality. ●Deformation and collapse of the toe of levee due to liquefaction of soil near the toe.	●Deformations from [1] to [7] have appeared due to tree invasion, causing impairment to the levee’s functionality.	●Erosion has caused the loss of erosion resistance, impairing the levee’s functionality.	●Water leakage and sand boil can be observed. ●In case water leakage and sand boil have been observed after floods.	D	●The function of levee is impaired andrepair, renewal, or other countermeasures are required.

*1: Considering the scale of the levee and the history of past damage, it is set for each river (general deformation).

*2: Excludes areas around structures such as sluiceways.

*3: Be careful if it is caused by the levee body or foundation ground.

*4: In addition to abnormalities caused by factors such as slope failures, levees constructed for road occupancy may also result in steepening slopes. Therefore, it is necessary to confirm the record of the levee.

4 Revetment

4.1 Inspection items

High-water revetment is generally installed for erosion/trench scouring measures, but in the case of a structural type in which water leakage and infiltration countermeasures are applied by water-blocking sheet piles and waterblocking sheets, etc., it is also effective as an infiltration countermeasure. In recent years, there have been many cases where covering the seawall with soil covering has been applied, so it is necessary to pay attention to the fact that the purpose of installation of each structural type is different when inspecting.

Table 2.5 Inspection Items for Revetment

Area	Inspection items
Levee revetment, High-water revetment, Low-water revetment	・Are there any deformations such as joints, cracks, or breakage on the revetment? ・In areas where the surface of the levee revetment and high-water revetment is covered as a measure against infiltration, is there any exposure or break of the waterblocking sheet? ・Is there any scouring or erosion of the revcetment and its edges? ・Has the concrete or steel structure deteriorated or corroded? ・Has stacked structure such as concrete blocks and discarded stones been deformed by subsidence, collapse, etc.? ・Is there any protrusion in the stacking structure of concrete blocks, etc.? ・Is there any riverbed degradation or local scouring occurring on the low-water revetment that could lead to concerns such as subsidence, collapse, or cave-ins?

There are a wide variety of types of revetments, but in the Guidelines, the following nine typical types of inspection items are presented.

Table 2.6 Types of Revetments

Structure	Kind	Summary
Pitching structure	Block lining revetment	Method for placing backfill concrete and installing concrete blocks.
	Wet stone pitching revetment	Method for placing backfill concrete and installing natural stones and wedge-shaped stones.
	Dry pitching revetment	Method of installing stone blocks by interlocking them on a slope.
Masonry structure	Block masonry revetment	Method for placing backfill concrete and installing concrete blocks.
	Wet stone masonry revetment	Method for placing backfill concrete and installing natural stones and wedge-shaped stones.
	Dry masonry revetment	Method of installing stone blocks by interlocking them on a slope.
Others	Slope crib revetment	Method of installing concrete formwork on a slope surface and covering the interior with stone or cast-in-place concrete.
	Articulated concrete mattress	Method of connecting concrete blocks with iron wires and laid on a slope.
	Iron wire basket revetment	Method in which steel wire is assembled in a basket shape and filled with stone

*1 If the slope is 1:1.0 or more, it is an attaching structure, and if it is less than 1:1.0, it is a masonry structure.

*2 Among the above types of revetments, revetments equipped with waterblocking sheet piles and water-blocking sheets are classified as leak and seepage countermeasure revetments, and revetments without water-blocking sheet piles or waterblocking sheets are classified as general erosion and trench revetments.

4.2 Evaluation items

The criteria for evaluating inspection results at each deformation of a revetment shall be established for each river based on its specific characteristics. For reference, Table 2.7 shows the established evaluation criteria, which were set based on existing literature and the actual maintenance practices of river management facilities to date.

Table 2.7 Criteria for Evaluating Inspection Results of Revetments

Type of deformation / Category		Evaluation of Each Deformation Part							Comprehensive Evaluation	
		[13] Damage to revetments and coverings		[14] Protrusion *2,3,4	[15] Scouring of the foundation		[16] Edge erosion		Category	Condition
		Revetments and coverings other than iron wire basket revetment	Iron wire basket revetment	Revetment	With foot protection work	Without foot protection work	Revetments other than articulated concrete mattress	Articulated concrete mattress		
a	No abnormality	●No abnormality	●No abnormality	●No abnormality	●No abnormality	●No abnormality	●No abnormality	●No abnormality	A	●No abnormality
b	Monitoring stage	●Deformation in joints and cracks (Gap larger than 2mm and smaller than the particle size of the backing material). ●Height differences (Visibly noticeable). ●Losses ●Water spring	●Corrosion of iron wire.	●Deformation in joints and cracks by protrusion (Gap larger than 2mm and smaller than the particle size of the backing material). ●Height diffirences (Visibly noticeable).	●Subsidence of foot protection work (Remaining installation width: two blocks or 2 m).	●Riverbed lowering in front of the foundation works (Riverbed elevation is at least as high as the top of the foundation works).	●Erosion near the edge (end-block) (Less than the thickness of the edge component).	●Erosion near the edge (Less than the thickness of the edge component).	B	●There is no hindrance to the function of revetments, but a potentially progressive abnormality has been identified and requires monitoring of its course.
c	Preventive maintenance stage	●Tree invasion. ●Deformations in joints and cracks (Gap larger than the particle size of the backing material). ●Height differences (at least half of the thickness of the stone or block). ●Caving (Condition verifiable through tapping inspection).	●Fracture of iron wire.	●Height differences by protrusion (at least half of the thickness of the stone or block). ●Deformations in joints and cracks (Gap larger than the particle size of the backing material). ●When there is suspicion of deformation of earthen levees, conduct a detailed inspection (including surveys) and take necessary measures.	●Subsidence of foot protection work (Decline in frontline of foot protection work).	●Foundation works exposed (The top surface of the foundation works exposed).	●Erosion near the edge (end-block) (Greater than the thickness of the edge component).	●Erosion near the edge (Greater than the thickness of the edge component).	C	●There is no hindrance to the function of revetments, but a progressive condition is recognized which should be addressed from a preventive maintenance perspective. ●Re-evaluation of the hindrance of the levee and revetment's functionality is required by detailed inspection (including survey).
d	Action stage	●Losses (Exposure of backfill soil)*2. ●Cave-ins and subsidence (Caused by suction). ●Tree invasion (Deformation has occurred in the revetment).	●Drain of filled material.	●Bank destruction due to protrusion.	●Floating foundation (Foundation works have been scoured down to their base, appearing to float).		●Erosion of the crest protection works (because of the progress of (i) edge erosion or (ii) erosion of the back of the crest protection works).	●Peeling up (The mattress is being rolled up due to erosion at the edge and the action of flowing water).	D	●The function of revetment is impaired andrepair, renewal, or other countermeasures are required.

*1: The revetments subject to evaluation under the Guidelines are the nine types listed in Table 2.6. When evaluating other types of revetments, refer to the Guidelines.

*2: Includes cases where waterblocking sheets or anti-seepage materials are exposed in addition to the backfill soil.

*3: Must be evaluated in conjunction with any deformation of the earthen levee.

*4: For mansory revetments, this phenomenon may be referred to as “protrusion”; for pitching revetments, it may be termed “lifting.”

5 Steel Sheet Pile Revetment

5.1 Inspection Items

Since it is difficult to perform a direct visual inspection of the steel sheet pile itself when the foot protection work is installed or due to invisibility due to the tidal section, it shall be possible to carry out the inspection at the time of surveying such as a periodic longitudinal and cross-sectional leveling. If the steel sheet pile itself is deformed, a detailed inspection (including a survey) shall be carried out as necessary.

Table 2.8 Inspection items for steel sheet pile revetment

Area	Inspection items
Steel sheet pile	・ Has the concrete or steel structure deteriorated or corroded? ・ Are there any uneven settlement or tilting in the concrete or steel structure, or are there any gaps or suctions at the joints with the soil structure?
Ground behind	・ Are there any subsidence or cave-ins in the ground behind the revetment?
Cap concrete	・ Has the concrete or steel structure deteriorated or corroded? ・ Are there any height differences, misalignments, or openings in the concrete joints and construction joints of the cap concrete?

5.2 Evaluation Items

The criteria for evaluating inspection results at each deformation of the steel sheet pile revetment shall be established for each river based on its specific characteristics. For reference, Table 2.9 shows the established evaluation criteria, which were set based on existing literature and the actual maintenance practices of river management facilities to date.

Table 2.9 Criteria for Evaluating Inspection Results of Steel Sheet Pile Revetments

Type of deformation / Category		Evaluation of Each Deformation Part					Comprehensive Evaluation	
		[19] Deformation, protrusion and breakage of steel sheet piles	[20] Corrosion of steel sheet piles (rust, holes, reduced wall thickness)	[21] Opening and missing steel sheet pile joints	[22] Subsidence and cave-in of the ground behind	[23] Deformation and damage of cap concrete	Cate-gory	Condition
a	No abnormality	●No abnormality	●No abnormality	●No abnormality	●No abnormality	●No abnormality	A	●No abnormality
b	Monitoring stage	●Minor tilting and protrusion of steel sheet piles	●Uneven corrosion	●Minor leakage from joints	●Minor crack on the ground behind	●Cracks, lifting, peeling, etc. ●Minor misalignments of the crest of steel sheet pile (cap concrete).	B	●There is no hindrance to the function of steel sheet pile revetments, but a potentially progressive abnormality has been identified and requires monitoring of its course.
c	Preventive maintenance stage	●Tilting and protrusion of steel sheet piles ●Minor damage	●Layered corrosion products on steel surfaces	●Significant leakage from joints	●Minor subsidence and cave-in of the ground behind	●Cracks which possibly affect durability. ●Misalignments of the crest of steel sheet pile (cap concrete) (Set the target to within 5 cm but adjust based on structural dimensions such as wall height).	C	●There is no hindrance to the function of steel sheet pile revetments, but a progressive condition is recognized which should be addressed from a preventive maintenance perspective. ●Re-evaluation of the hindrance of the levee and steel sheet pile revetment's functionality is required by detailed inspection (including survey).
d	Action stage	●Significant protrusion of steel sheet piles ●Holes caused by damage	●Significant layered corrosion, holes, and leakage	●Significant joint corrosion caused by leakage	●Significant subsidence and cave-in of the ground behind, obvious hollowing out	●Cross-sectional defects affecting structural strength. ● Misalignments of the crest of steel sheet pile (cap concrete) (Set the target to 5 cm or more but adjust based on structural dimensions such as wall height).	D	●The function of steel sheet pile revetment is impaired andrepair, renewal, or other countermeasures are required.

* In the type of deformation from [17] to [21], the deformation can be confirmed at the time of surveying such as periodic longitudinal and cross-sectional leveling and detailed inspection (including a survey) shall be carried out as necessary.

6 Foot Protection Work, Groin

6.1 Inspection items

Since the deformation of the foot protection work and groin is caused by flowing water force, it is necessary to keep in mind whether a change in the waterway has occurred, and pay particular attention to the post-flood inspection after a large flood.

Table 2.10 Inspection Items for Foot Protection Work and Groin

Area	Inspection items
Foot Protection Work, groin	・ Is there any deformation of the root protection work (or has it been worsened than before the flood season)? ・ Is there any deformation of the groin (or has it been worsened than before the flood season)? ・ Is there any riverbed degradation or local scouring, which may be deformations such as subsidence, collapse, and depression in the root protection work and groin? ・ Are there any deformations, damage, or corrosion on the wooden components that impair the function of the facility?

7 Storm Surge Levee (Covered Structure Levee)

7.1 Inspection Items

It should be noted that in many cases of damage to storm surge levees, the cavity behind the cladding, the sucking out of the foundation by scouring, and the deformation due to uneven settlement are the causes. If the existence of a cavity is suspected by visual inspection, an inspection such as measurement of the invisible part shall be carried out as necessary.

Table 2.11 Inspection Items for Storm Surge Levee (Covered Structure Levee)

Area	Inspection items
Parapet work (and body work of breast wall)	・ Are there any cracks? ・ Are there any peeling, flaking, or defects? ・ Is there rust juice, exposed rebar, etc.? ・ Are there any height differences, misalignments, or openings in the span joints and construction joints?
Crest covering	・ Is there any subsidence or cave-in? ・ Is there any overgrowth of vegetation? ・ Are there any cracks? ・ Are there any height differences, misalignments, or openings in the span joints and construction joints? ・ Are there any peeling, flaking, or defects?
Front and back covering	・ Are there any cracks? ・ Is there any subsidence or cave-in? ・ Are there any height differences, misalignments, or openings in the span joints and construction joints? ・ Are there any traces of water leakage or eruption? ・ Is there any overgrowth of vegetation? ・ Are there any peeling, flaking, or defects? ・ Is there rust juice, exposed rebar, etc.?
Drainage	・ Are there any deformations such as height differences, misalignments, openings, or water leaks in the joints? Also, have they worsened from the past?
Wave breaker work, foot protection work	・ Are there any moving or scattering blocks? ・ Is there any subsidence? ・ Are there any breaks, cracks, or damage to the blocks?

7.2 Evaluation items

The criteria for evaluating inspection results at each deformation of the storm surge levee shall be established for each river based on its specific characteristics. For reference, Table 2.12 shows the established evaluation criteria, which were set based on existing literature and the actual maintenance practices of river management facilities to date.

For parts other than the body of the storm surge levee, such as those of earthen levee, revetment (covered area), and steel sheet pile revetment, the criteria for each structural classification shall be applied.

Table 2.12 Criteria for Evaluating Inspection Results of the Body of Storm Surge Levee and Special Levee

Type of deformation / Category		Evaluation of Each Deformation Part		Comprehensive Evaluation	
		[17] Damage to the main body	[18] Joint deformation, break	Category	Condition
a	No abnormality	●No abnormality	●No abnormality	A	●No abnormality
b	Monitoring stage	●Cracks, lifting, peeling, rust juice, etc.	●Openness and height difference (more than 2cm and less than 7cm) of joints (cut off plates). *2 cm: Lower limit of deformation capacity for standard cut off plates. 7 cm: Actual break point of cut off plates based on the Sluiceways Reinforcement Manual.	B	●There is no hindrance to the function of revetments, but a potentially progressive abnormality has been identified and requires monitoring of its course.
c	Preventive maintenance stage	●Cracks which possibly affect durability. ●Cross-sectional defects ●Rebar corrosion	●Openness and height difference (more than 7cm) of joints (cut off plates). *7 cm: Actual break point of cut off plates based on the Sluiceways Reinforcement Manual.	C	●There is no hindrance to the function of revetments, but a progressive condition is recognized which should be addressed from a preventive maintenance perspective. ●Re-evaluation of the hindrance of the levee and revetment's functionality is required by detailed inspection (including survey).
d	Action stage	●Cross-sectional defects which affect structural strength	●Break of cut off plates ●Occurrence of height difference suspected to be due to deformation of foundation (earthen levee area).	D	●The function of revetment is impaired andrepair, renewal, or other countermeasures are required.

*1 The body of storm surge levee and special levee indicates their parapet and body of the free-standing structure. Their coverings, due to their structural similarity with revetments, are evaluated as revetments.

*2 "[18] Joint deformation, break" refers to the joint between parapet spans and the joints on the body of spacial levee. The joint with revetments are not included.

*3 The deformation related to [17] and [18] shall be evaluated based on the high-water level (HWL) and the elevation of the ground behind.

8 Special Levee

8.1 Inspection items (Free-standing Structural Levee)

Inspections of the foot protection work shall be carried out only in the case of facilities that can be visually inspected from land. If the existence of a cavity is suspected by visual inspection, an inspection such as measurement of the invisible part shall be carried out as necessary.

Table 2.13 Inspection Items for Free-standing Structural Levee

Area	Inspection items
Body, parapet work	・ Are there any cracks? ・ Are there any peeling, flaking, or defects? ・ Is there rust juice, exposed rebar, etc.? ・ Are there any height differences, misalignments, or openings in the span joints and construction joints?
Drainage	・ Are there any height differences, misalignments, openings in the joints?
Wave breaker work, foot protection work	・ Are there any moving or acattering blocks? ・ Is ther any subsidence? ・ Are there any breaks, cracks, or damage ot the blocks?

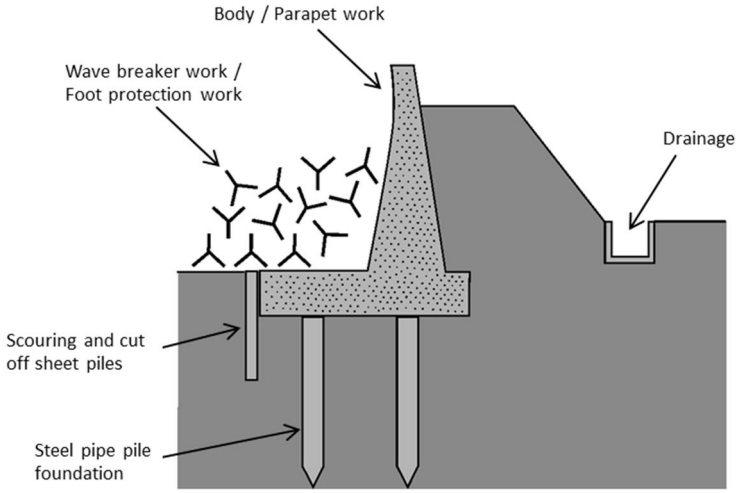


Figure 2.11 Image of a Free-standing Structural Levee

8.2 Inspection items (Butress Structural Levee)

For the buttress structural levee, inspection items were set for buttress (parapet). If the front slope is a concrete retaining wall structure, the part shall be inspected in accordance with the free-standing structural levee.

Table 2.14 Inspection Items for Butress Structural Levee

Area	Inspection items
Butress (parapet)	・ Is ther any subsidence or cave-in? ・ Are there any cracks? ・ Are there any peeling, flaking, or defects? ・ Is ther rust juice, exposed reber, etc.? ・ Are ther any height differences, misalignments, or opening in the span joints and construction joints?

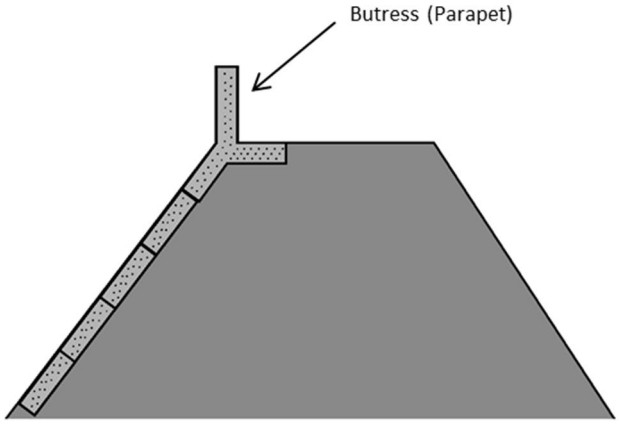


Figure 2.12 Image of a Butress Structural Levee

8.3 Evaluation items

The criteria for evaluating inspection results at each deformation of the body of the special levee shall be established for each river based on its specific characteristics. Since the evaluation items of the special levees are the same as those for the above-mentioned storm surge levees (covered structure levee), the evaluation shall be carried out with reference to their above-mentioned guidelines (Table 2.12).

For parts other than the body of the special levee, such as those of earthen levee, revetment (covered area), and steel sheet pile revetment, the criteria for each structural classification shall be applied.

9 Land Lock

9.1 Inspection items

Inspection items for land locks shall be set after coordination with respect to overlap with inspections of machinery and equipment.

Table 2.15 Inspection Items for Land Lock

Area	Inspection items
Land Lock	・ Are there any height differences, misalighments, or joint openings with the crest of the adjuscent levees? ・ Is there any tilt or deflection of the door body? ・ Is ther rust on the door body or wheels? ・ Is there any foreign matter such as debris between the door body and the levees?

9.2 Evaluation items

Since land locks mainly comprise machinery equipments, evaluation shall be conducted properly according to the following other regulations etc.

- "Revision of the Inspection, Maintenance, and Renewal Manual (Draft) for River Gates and River Pump Equipment (Draft)" (March 31, 27 National General Provision No. 11 / National Water Ring Insurance No. 8 General Policy Bureau Public Works Planning and Coordination Division Construction Safety Planning Office, Water Management and Land Conservation Bureau Notice of the Director of the River Conservation Planning Office, River Environment Division, Water Management and Land Conservation Bureau)"
- "Partial revision of the Technical Standards for Dams and Weir Facilities (Draft)" (March 31, 28 Kokugiden No. 72, Kokusō No. 80, National Water Ring No. 140, National Water Control No. 142 Notice of the Director of the Technical Research Division of the Minister's Secretariat, Director of the Public Works Planning and Coordination Division of the Policy Bureau, Director of the River Environment Division of the Water Management and Land Conservation Bureau, and the Director of the Flood Control Division)",
- "Evaluation Procedures for Machinery and Telecommunications Facilities (March 28, 29) Assistant Director, Telecommunications Office, Technical Research Division, Minister's Secretariat, Assistant Director, Construction Safety Planning Office, Public Works Planning and Survey Division, Policy Bureau, Assistant Director, River Conservation Planning Office, River Environment Division, Water Management and Land Conservation Bureau, Assistant Director, Administrative Liaison of the Director of the Flowing Water Management Office)."

Ⅲ. Inspection and Evaluation of River Structures (including levees around structures)

1 Purpose

The inspection targets of river structures, such as sluiceways, are classified into levees around structures and the body of the structures.

Visual inspections of each part of the body of the structure and the levee around it shall be carried out for the deterioration status such as cracks and joints openings in the concrete part, uplift of the top and slope of the upper part of the structure, the condition of the cracks, the opening of the joints of each part of the structure, etc., and the necessity of detailed inspection (including survey) or repair shall be evaluated based on the progress of the deterioration.

2 Inspection items

- Inspections are carried out for each facility, but the items to be inspected vary greatly depending on the structural characteristics of the facility. The body of the structures, such as sluiceways, sluice gates, weirs, drainage stations, and other civil engineering facilities, as well as ground stills, shall be divided into concrete structures composed of concrete wall columns and floor slabs, and steel structures, to establish inspection items.
- To observe the course of abnormalities of river structures, fixed-point observation (including observations) shall be carried out as necessary.
- As abnormalites caused by fluctuations in the surrounding riverbed, abnormalities of the body of the structure, such as subsidence and collapse of facilities, which are signs of local scouring and riverbed degradation, are set as inspection items.
- To ensure the functional and structural stability of each facility, it is basic to set target values for maintenance and management, such as local scouring depth. The target value can be set as design guidelines, such as empirically setting the target embedment depth for revetments 1m below the deepest riverbed elevation.
- The scoured area is often under the surface even in normal discharge, and it is difficult to grasp the depth by visual inspection. Therefore, visual inspection will indirectly grasp the subsidence of river structures and the decrease in water level during normal water due to riverbed degradation. If necessary, an inspection is carried out by measurements such as surveying of the scouring depth.

Table 3.1 Inspection Items for River Structures (including levees around structures)

	Area or type of work		Inspection items
Sluice-ways	Levees around the structure	Crest and slope of the upper part of the structure	・ Is there any change in the uplift and the cracks at the crest and the slope of the upper part of the structure? Are the openings and the height differences expanding? ・ Are there any traces of water leakage, sand boil or other sucking out from the crest of the upper part of the structure, the bottom of the levee, the banquette, and the levee waterway? ・ Are there any cave-ins at the crest of the upper part of the structure, at the bottom of the levee, the banquette, or the levee waterway?
		Joint between structures	・ Is there any change in the opening of the joints of each part of the structure? Are the openings and the height differences expanding? ・ Are there any traces of sucking out from the joints of the various parts of the structure?
	Body of the structure	Box, box coupling	・ Has the concrete or steel structure deteriorated or corroded? ・ Are there any uneven settlement or tilting in the concrete or steel structure, or are there any gaps or suction at the joints with the soil structure? ・ Is there any change in the condition of the bending or flection of the box, the opening of the joint, or the crack of the box? Is it expanding? ・ Is there sediment accumulation or abnormal growth of vegetation and aquatic plants in waterways such as sluiceways and sedimentation ponds, control ponds, driving channels, etc. at drainage stations?
		Concrete structures such as gateposts, battlements, and wing walls, and steel structures	・ Has the concrete or steel structure deteriorated or corroded? ・ Are there any uneven settlement or tilting in the concrete or steel structure, or are there any gaps or suction at the joints with the soil structure? ・ Are there any uneven settlement or tilting in the sluiceway, sluice gate body, and surrounding levees, or are there any gaps or suction at the joints with the soil structure?
		Gate operation floor, operation room	Inspection of civil engineering structures such as concrete is the same as that of [Concrete structures such as gate posts, battlements, and wing walls, and steel structures]. For inspections of machinery and telecommunications facilities, see other guidelines*.
	Approach revetment		See “II. 4. Revetment”
Sluice gates	Levees around the structure	Crest and slope of the upper part of the structure	Conform to “Crest and slope of the upper part of the structure” of “Levees around the structure” of “Sluiceway”.
		Joint between structures	Same as “Joint between structures” of “Levees around the structure” of “Sluiceways”.
	Body of the structure	Floor slabs, apron	Conform to “Floor slabs, apron” of “Body of structures” of “Weires and Ground still”.
		Concrete structures such as weir columns, gateposts, battlements, and wing walls, and steel structures	Same as “Concrete structures such as gate posts, battlements, and wing walls, and steel structures” of “Body of structures” of “Sluiceways”.
		Gate operation floor, operation room	Same as “Gate operation table, operation room” of “Body structures” of “Sluiceways”.
	Approach revetment		See "II. 4. Revetment"
	Revetment works		See "Upstream and downstream riverbeds, revetment works” of “Weires, ground still".
Weires, ground still	Upstream and downstream riverbeds, revetment works		・ Is there any riverbed lowering or scouring that may affect the stability of revetment works and the body of weires and ground still? ・ Is there any accumulation in the upstream part of the body that is problematic for flood control?
	Body of the structure	Floor slabs, apron	・ Do concrete structures that cross the riverbed, such as weirs and ground stills, have cracks, damage or worn in apron by sand and gravel, or opened seams?
		Concrete and steel	Same as "Concrete structures such as gate posts, battlements, and wing walls,

		structures such as weir comumns and gateposts	and steel structures” of “Body of structures” of “Sluiceways”.
		Locks, flushing gates, water intakes, gate operation floor, operation room	Same as " Gate operation table, operation room” of “Body of structures” of “Sluiceways”.
	Fishways		・ Is there any deformations such as breakage or accumulation of sediment or driftwood in the fishway of weirs etc.?
	Approach revetment		・ Are there any subsidence or colapse in the retaining walls and revetments, which are signs of riverbed degradation or local scouring? Is there any deformation caused by flooding or riverbed fluctuations in the high-water channel protection work?
Others	Other Structures		・ Are there any scouring or deformation in the pipelines and handholes installed for laying optical cables that may affect the function of optical cables?

* For inspections of machinery equipments and telecommunications facilities, refer to "Standard Guidelines for Inspection and Maintenance of River Gate Facilities (Draft), March 2016", "Standard Guidelines for Inspection and Maintenance of River Pump Facilities (Draft), March 2016", and "Inspection Standards for Telecommunications Facilities (Draft), November 2016".

3 Sluiceways

3.1 Inspection items

The inspection items are classified into “levees around the structure”, “body of the structure”, and “approach revetment”, and set for each part. The inspection items for sluiceways shall be set in coordination with the inspection of machinery equipments.

Table 3.2 Inspection items for sluiceways (including levees around the structure)

Area or type of work		Inspection items
Levees around the structure	Crest and slope of the upper part of the structure	・ Is there any change in the uplift and the cracks at the crest and the slope of the upper part of the structure? Are the openings and the height differences expanding? ・ Are there any traces of water leakage, sand boil or other sucking out from the crest of the upper part of the structure, the bottom of the levee, the banquette, and the levee waterway? ・ Are there any cave-ins at the crest of the upper part of the structure, at the bottom of the levee, the banquette, or the levee waterway?
	Joint between structures	・ Is there any change in the opening of the joints of each part of the structure? Are the openings and the height differences expanding? ・ Are there any traces of sucking out from the joints of the various parts of the structure?
Body of the structure	Box, box coupling	・ Has the concrete or steel structure deteriorated or corroded? ・ Are there any uneven settlement or tilting in the concrete or steel structure, or are there any gaps or suction at the joints with the soil structure? ・ Is there any change in the condition of the bending or flection of the box, the opening of the joint, or the crack of the box? Is it expanding? ・ Is there sediment accumulation or abnormal growth of vegetation and aquatic plants in waterways such as sluiceways and sedimentation ponds, control ponds, driving channels, etc. at drainage stations?
	Concrete structures such as gateposts, battlements, and wing walls, and steel structures	・ Has the concrete or steel structure deteriorated or corroded? ・ Are there any uneven settlement or tilting in the concrete or steel structure, or are there any gaps or suction at the joints with the soil structure? ・ Are there any uneven settlement or tilting in the sluiceway, sluice gate body, and surrounding levees, or are there any gaps or suction at the joints with the soil structure?
	Gate operation floor, operation room	・ Has the concrete or steel structure deteriorated or corroded? For inspections of machinery and telecommunications facilities, see other guidelines*.
Approach revetment		See “II. 4. Revetment”

* For inspections of machinery equipments and telecommunications facilities, refer to "Standard Guidelines for Inspection and Maintenance of River Gate Facilities (Draft), March 2016", "Standard Guidelines for Inspection and Maintenance of River Pump Facilities (Draft), March 2016", and "Inspection Standards for Telecommunications Facilities (Draft), November 2016".

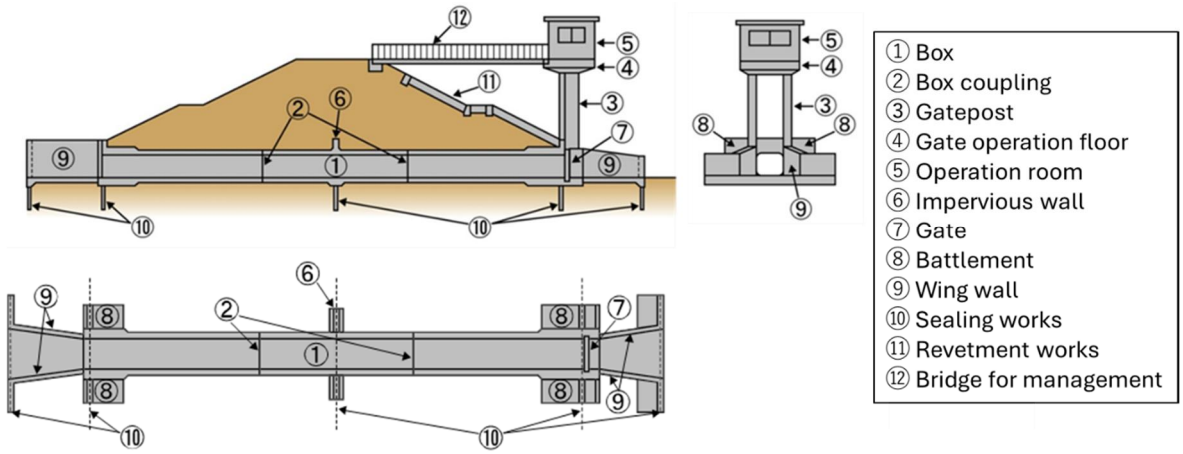


Figure 3.1 Names of Sluiceway Components

(Source: River and Sediment Control Technical Standards (Draft) Explanation and Design [I.], September 1997, p.95）

If a non-soil structure is included in the levee, the boundary between the structure and the levee is likely to become a path for seepage water, which may cause leakage and become a weak point of the levee. In sluiceways, there are cases where water paths are formed along the boundary between the gateposts and boxes and the levee, and leakage occurs during flooding. In facilities with pile foundations and/or on soft ground, the following problems are likely to occur due to differences in subsidence characteristics.

- Caving under the floor slab of the main body due to subsidence of the levee and foundation ground (consolidation settlement, immediate subsidence)
- Uplift, cave-ins, and cracks in levees
- Opening of the main body joint due to subsidence of the levee or the ground, rupture of the water stop plate, opening of the joint with the wing wall, cracks in the body, battlements, wing walls, etc.
- Occurrence of piping around the body, formation of water paths, and associated caving around the body

Attention to above issues shall be made for the inspection of levees around structures such as sluiceways (Fig. 3.2). The above phenomena are likely to occur in facilities with pile foundations installed in sections of high levees and facilities on soft ground, special attention should be paid to the history of past cavities and cracks, the condition of the ground, etc.

The inspection of the levee around the structure such as the sluiceway is closely related to the deformation of the structure itself. Therefore, the inspection items include matters related to the deformation of the body of the structure. The sluiceways, etc. permitted by river administrators are basically inspected by their installers. But since they are closely related to the levees, river administrators will coordinate with their installers to ensure their inspections, by the river administrators if necessary. If a deformation of a permitted structure is found through inspection, etc., information shall be promptly provided to its installer and the response shall be confirmed.

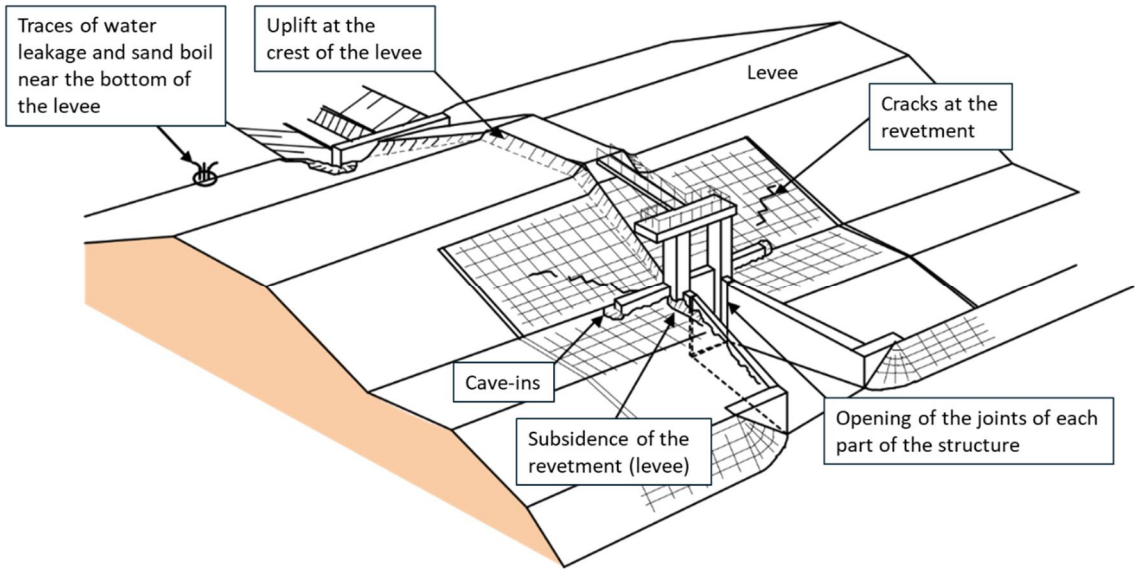


Figure 3.2 Events confirmed visually in the levee around structures such as sluiceways

Sluiceways have been conventionally designed as solid structures. Consequently, when subsidence occured on soft ground, significant relative subsidence gap between the sluiceways and surrounding levees could occur, necessitating vigilance against deformations such as cracks and cavings. After the design method for sluiceways was changed in 1998 to flexible structures (allowing subsidence), the box and the levee behave in an integrated manner, cracks and cavings have been less likely to occur. On the other hand, issues such as sediment accumulation due to joint gaps and box subsidence have begun to arise. Based on the above, when inspecting sluiceways, utmost attention must be also paid to their structural form.

In addition, the flexible structure sluiceway allows the amount of subsidence so that it can follow the subsidence and displacement of the ground in the box axis direction, and expects the deformation performance of the joint mainly for deflection in the box axis direction. For this reason, it is particularly important to check whether the displacement amount of the joint part is within the allowable value in the inspection.

3.2 Evaluation items

The criteria for evaluating inspection results at each deformation of a sluiceway shall be established for each river based on its specific characteristics. For reference, Table 3.3 shows the established evaluation criteria, which were set based on existing literature and the actual maintenance practices of river management facilities to date.

Table 3.3 Criteria for Evaluating Inspection Results of Sluiceways

Type of deformation / Category		Evaluation of Each Deformation Part							Comprehensive Evaluation					
									Civil engineering facility		Mechanical equipment	Telecommu-nications facility	Comprehensive Evaluation (Evaluation of structure)	
		[1] Cracks and loosening of surrounding levees, cracks in the approach revetments	[2] Cavitation under the box, etc.	[3] Damage to boxes, etc. (boxes, battlements, wing walls etc. which are visibly detectable and may affect the damage to the levee)	[4] Joint (including joints with wing walls) deformation, breaking	[5] Deformation or damage to gateposts, etc. (gateposts, gate operation floors, etc. which are visibly detectable and may affect the function of the gate)	[6] Sediment accumulation in the box	[7] Excessive subsidence of the box	Category	Condition			Category	Condition
a	No abnormality	●No abnormality	●No abnormality	●No abnormality	●No abnormality (Openness of joints is less than 2cm)	●No abnormality	●No abnormality	●No abnormality	A	●No abnormality			A	●No abnormality
b	Monitoring stage	●Cracks on pavements at the crest of the levee. ●Cracks in the mounting revetments.	●Cracks on pavements at the crest of the levee around the box (areas around the box end inferred from gateposts, etc.). ●Uplift of the box (less than 10cm). ●Wetification at the foot of the levee.	●Cracks, lifting, peeling, rust juice, etc.	●Openness of joints (cut off plates) (more than 2cm and less than 7cm). ●Openness of flexible joints (below the acceptable limits). *2 cm: Lower limit of deformation capacity for standard cut off plates. 7 cm: Actual break point of cut off plates based on the Sluiceways Reinforcement Manual.	●Cracks, lifting, peeling, rust juice, etc.	●If management is impeded, promptly remove the sediment.	●Subsidence of the box (below the freeboard of the sluiceway cross-section).	B	●There is no hindrance to the function of the sluiceway, but a potentially progressive abnormality has been identified and requires monitoring of its course.	The evaluation of mechanical equipments shall be conducted based on inspection results in accordance with the relevant notifications and other documents specified in Section I.2. Scope of Application.	The evaluation of telecommu-nications facilities shall be conducted based on inspection results in accordance with the relevant notifications and other documents specified in Section I.2. Scope of Application.	B	●There is no hindrance to the function of the sluiceway, but a potentially progressive abnormality has been identified and requires monitoring of its course.
c	Preventive maintenance stage	●Cracks and loosening of the levee body.	●Uplift of the box (more than 10cm and less than 30cm). ●Cavitation confirmed by detailed inspections (inclufing surveys).	●Cracks which possibly affect durability. ●Cross-sectional defects. ●Rebar corrosion.	●Openness of joints (cut off plates) (more than 7cm). ●Openness of flexible joints (beyond the acceptable limits). *7 cm: Actual break point of cut off plates based on the Sluiceways Reinforcement Manual.	●Cracks which possibly affect durability. ●Cross-sectional defects. ●Rebar corrosion. ●Tilting of gateposts.			C	●There is no hindrance to the function of the sluiceway, but a progressive condition is recognized which should be addressed from a preventive maintenance perspective. ●Re-evaluation of the hindrance of the sluiceway's functionality is required by detailed inspection (including survey).			C	●There is no hindrance to the function of the sluiceway, but a progressive condition is recognized which should be addressed from a preventive maintenance perspective. ●Re-evaluation of the hindrance of the sluiceway's functionality is required by detailed inspection (including survey).
d	Action stage	●Water leakage from the levee body.	●Uplift of the box (more than 30cm). ●Water leakage from the levee body, occurrence of piping.	●Cross-sectional defects which affect structural strength.	●Break of watertight rubber at joints and/or cut off plates.	●Cross-sectional defects which affect structural strength. ●Failure to open and close the gate.		●Subsidence of the box (beyond the freeboard of the sluiceway cross-section).	D	●The function of the sluiceway is impaired and repair, renewal, or other countermeasures are required.			D	●The function of the sluiceway is impaired and repair, renewal, or other countermeasures are required.

4 Sluice Gate

4.1 Inspection items

The inspection items for the sluice gate were divided into "levees around the structure", "body of structures", "approach revetment", and "flooring", and set for each part. In addition, the inspection items of the sluice gate shall be set after coordination with the inspection of machinery equipments.

Table 3.4 Inspection items for sluice gates (including levees around structures)

Location or type of work		Inspection items
Levees around the structure	Crest and slope of the upper part of the structure	Conform to “Crest and slope of the upper part of the structure” of “Levees around the structure” of “Sluiceway”.
	Joint between structures	Same as “Joint between structures” of “Levees around the structure” of “Sluiceway”.
Body of structures	Floor slabs, apron	Conform to “Floor slabs, apron” of “Body of structures” of “Weires and Ground still”.
	Concrete structures such as weir columns, gateposts, battlements, and wing walls, and steel structures	Same as “Concrete structures such as gate posts, battlements, and wing walls, and steel structures” of “Body of structures” of “Sluiceway”.
	Gate operation floor, operation room	Same as “Gate operation table, operation room” of “Body structures” of “Sluiceway”.
Approach revetment		See "II. 4. Revetment"
Flooring		See "Upstream and downstream riverbeds, revetment works” of “Weires, ground still".

* For inspections of machinery equipments and telecommunications facilities, refer to "Standard Guidelines for Inspection and Maintenance of River Gate Facilities (Draft), March 2016", "Standard Guidelines for Inspection and Maintenance of River Pump Facilities (Draft), March 2016", and "Inspection Standards for Telecommunications Facilities (Draft), November 2016".

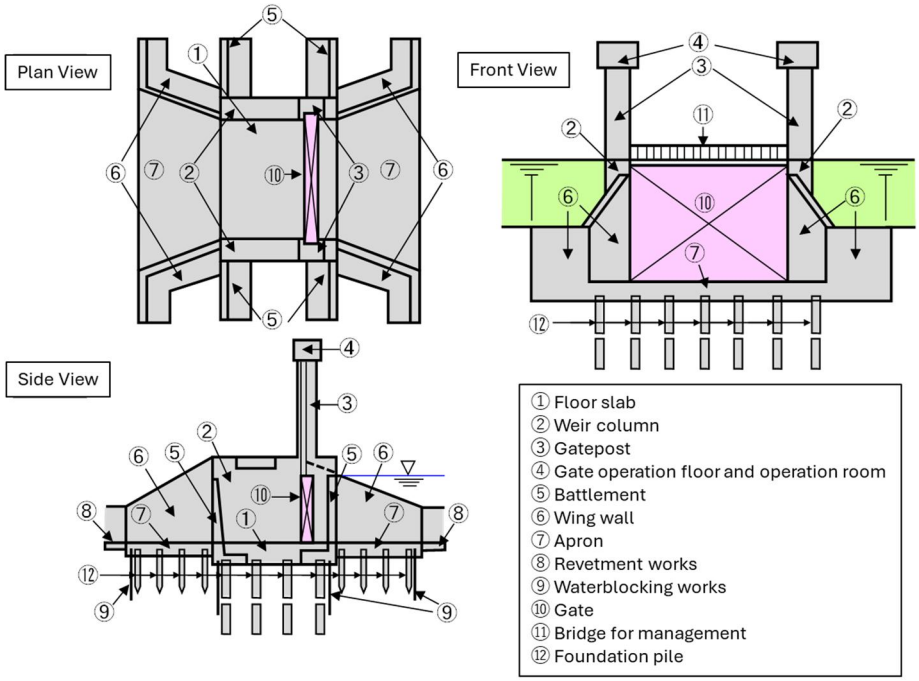


Figure 3.6 Names of Sluice Gate Components

(Source: Added foundation piles to River and Sediment Control Technical Standards (Draft) Explanation and Design [I.], September 1997, p.108）

4.2 Evaluation items

The criteria for evaluating inspection results at each deformation of a sluice gate shall be established for each river based on its specific characteristics. For reference, Table 3.5 shows the established evaluation criteria, which were set based on existing literature and the actual maintenance practices of river management facilities to date.

Table 3.5 Criteria for Evaluating Inspection Results of Sluice Gates

Type of deformation / Category		Evaluation of Each Deformation Part					Comprehensive Evaluation					
		[1] Cracks and loosening of surrounding levees, cracks in the approach revetments	[2] Deformation or damage of weir columns, floor slabs, battlements, wing walls, and apron	[3] Joint (joints with wing walls) deformation, breaking	[4] Deformation or damage to gateposts, etc. (gateposts, gate operation floors, etc. which are visibly detectable and may affect the function of the gate)	[5] Sediment accumulation in waterways	Civil engineering facility		Mechanical equipment	Telecommu-nications facility	Comprehensive Evaluation (Evaluation of structure)	
							Category	Condition			Category	Condition
a	No abnormality	●No abnormality	●No abnormality	●No abnormality (Openness of joints is less than 2cm)	●No abnormality	●No abnormality	A	●No abnormality	The evaluation of mechanical equipments shall be conducted based on inspection results in accordance with the relevant notifications and other documents specified in Section I.2. Scope of Application.	The evaluation of telecommu-nications facilities shall be conducted based on inspection results in accordance with the relevant notifications and other documents specified in Section I.2. Scope of Application.	A	●No abnormality
b	Monitoring stage	●Cracks on pavements at the crest of the levee. ●Cracks in the mounting revetments.	●Cracks, lifting, peeling, rust juice, etc.	●Openness of joints (cut off plates) (more than 2cm and less than 7cm). ●Openness of flexible joints (below the acceptable limits). *2 cm: Lower limit of deformation capacity for standard cut off plates. 7 cm: Actual break point of cut off plates based on the Sluiceways Reinforcement Manual.	●Cracks, lifting, peeling, rust juice, etc.	●If management is impeded, promptly remove the sediment.	B	●There is no hindrance to the function of the sluice gate, but a potentially progressive abnormality has been identified and requires monitoring of its course.			B	●There is no hindrance to the function of the sluiceway, but a potentially progressive abnormality has been identified and requires monitoring of its course.
c	Preventive maintenance stage	●Cracks and loosening of the levee body.	●Cracks which possibly affect durability. ●Cross-sectional defects. ●Rebar corrosion.	●Openness of joints (cut off plates) (more than 7cm). ●Openness of flexible joints (beyond the acceptable limits). *7 cm: Actual break point of cut off plates based on the Sluiceways Reinforcement Manual.	●Cracks which possibly affect durability. ●Cross-sectional defects. ●Rebar corrosion. ●Tilting of gateposts.		C	●There is no hindrance to the function of the sluice gate, but a progressive condition is recognized which should be addressed from a preventive maintenance perspective. ●Re-evaluation of the hindrance of the sluice gate's functionality is required by detailed inspection (including survey).			C	●There is no hindrance to the function of the sluiceway, but a progressive condition is recognized which should be addressed from a preventive maintenance perspective. ●Re-evaluation of the hindrance of the sluiceway's functionality is required by detailed inspection (including survey).
d	Action stage	●Water leakage from the levee body.	●Cross-sectional defects which affect structural strength.	●Break of watertight rubber at joints and/or cut off plates.	●Cross-sectional defects which affect structural strength. ●Failure to open and close the gate.		D	●The function of the sluice gate is impaired and repair, renewal, or other countermeasures are required.			D	●The function of the sluiceway is impaired and repair, renewal, or other countermeasures are required.

5 Weirs and Ground Stills

5.1 Inspection items

Weirs and ground stills, though serving different functions, comprise common components excluding mechanical equipments: body, apron, revetment works, fishways, etc. Therefore, both are covered in this same chapter. The inspection items are classified into “upstream and downstream riverbeds, revetment works”, “body of the structure”, “fishways”, and “approach revetment”, and set for each part. The inspection items for weirs and ground stills shall be set in coordination with the inspection of machinery equipments.

Table 3.6 Inspection items for weirs and groud stills

Location or type of work		Inspection items
Upstream and downstream riverbeds, revetment works		・ Is there any riverbed lowering or scouring that may affect the stability of revetment works and the body of weires and ground still? ・ Is there any accumulation in the upstream part of the body that is problematic for flood control?
Body of the structure	Floor slabs, apron	・ Are there any cracks, damage or worn by sand and gravel, or opened seams?
	Concrete and steel structures such as weir columns and gateposts	・ Has the concrete or steel structure deteriorated or corroded? ・ Are there any uneven settlement or tilting in the concrete or steel structure, or are there any gaps or suction at the joints with the soil structure?
	Locks, flushing gates, water intakes, gate operation floor, operation room	・ Has the concrete or steel structure deteriorated or corroded?
Fishways		・ Are there any deformations? ・ Is there any sediment or driftwood accumulation?
Approach revetment		・ Are there any subsidence or colapse in the retaining walls and revetments, which are signs of riverbed degradation or local scouring? ・ Is there any deformation caused by flooding or riverbed fluctuations in the high-water channel protection work?

* For inspections of machinery equipments and telecommunications facilities, refer to "Standard Guidelines for Inspection and Maintenance of River Gate Facilities (Draft), March 2016", "Standard Guidelines for Inspection and Maintenance of River Pump Facilities (Draft), March 2016", and "Inspection Standards for Telecommunications Facilities (Draft), November 2016".

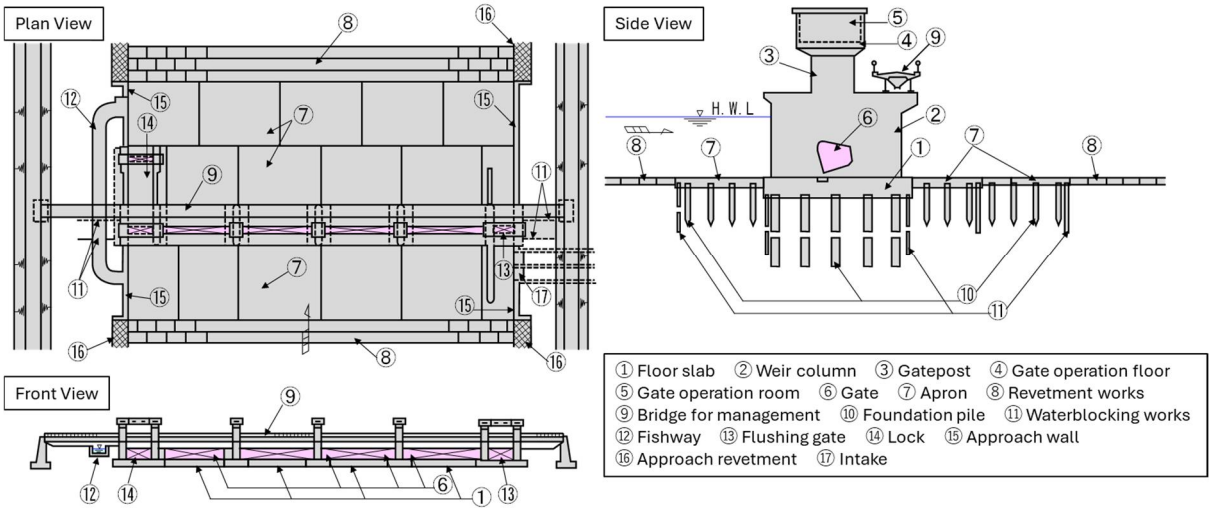


Fig. 3.7 Names of Components of the Movable Weir Equipped with Lift Gates

(Source: Added foundation piles to River and Sediment Control Technical Standards (Draft) Explanation and Design [I.], September 1997, p.61)

5.2 Evaluation items

The criteria for evaluating inspection results at each deformation of a weir or a ground still shall be established for each river based on its specific characteristics. For reference, Table 3.7 shows the established evaluation criteria, which were set based on existing literature and the actual maintenance practices of river management facilities to date.

Table 3.7 Criteria for Evaluating Inspection Results of Weirs and Grounds Stills

Type of deformation / Category		Evaluation of Each Deformation Part*1				Comprehensive Evaluation					
		[1] Deformation and damage of apron and revetment works, etc., scouring of riverbeds upstream and downstream*2	[2] Deformation and damage of floor slabs, weir columns, gateposts, etc. (gateposts, gate operation floors, etc. which are visibly detectable and may affect the function of the gate)	[3] Deformation and damage of the fishway	[4] Sediment accumulation in the river channel (around the gate), upstream of the main body, inside the lock, and in the fishway	Civil engineering facility		Mechanical equipment	Telecommu-nications facility	Comprehensive Evaluation (Evaluation of structure)	
						Category	Condition			Category	Condition
a	No abnormality	●No abnormality	●No abnormality	●No abnormality (Openness of joints is less than 2cm)	●No abnormality	A	●No abnormality	The evaluation of mechanical equipments shall be conducted based on inspection results in accordance with the relevant notifications and other documents specified in Section I.2. Scope of Application.	The evaluation of telecommu-nications facilities shall be conducted based on inspection results in accordance with the relevant notifications and other documents specified in Section I.2. Scope of Application.	A	●No abnormality
b	Monitoring stage	●Cracks, lifting, peeling, rust juice, etc. ●Deformation of revetment works (ex. cutting of connecting hardware of the revetment blocks).	●Cracks, lifting, peeling, rust juice, etc.	●Cracks, lifting, peeling, rust juice, etc.	●If management is impeded, promptly remove the sediment.	B	●There is no hindrance to the function of the weir, but a potentially progressive abnormality has been identified and requires monitoring of its course.			B	●There is no hindrance to the function of the weir, but a potentially progressive abnormality has been identified and requires monitoring of its course.
c	Preventive maintenance stage	●Cracks which possibly affect durability. ●Cross-sectional defects. ●Rebar corrosion. ●Scouring in the upstream and downstream, subsidence/runoff of the part of revetment works.	●Cracks which possibly affect durability. ●Cross-sectional defects. ●Rebar corrosion. ●Tilting of gateposts.	●Cracks which possibly affect durability. ●Cross-sectional defects. ●Rebar corrosion.		C	●There is no hindrance to the function of the weir, but a progressive condition is recognized which should be addressed from a preventive maintenance perspective. ●Re-evaluation of the hindrance of the weir's functionality is required by detailed inspection (including survey).			C	●There is no hindrance to the function of the weir, but a progressive condition is recognized which should be addressed from a preventive maintenance perspective. ●Re-evaluation of the hindrance of the weir's functionality is required by detailed inspection (including survey).
d	Action stage	●Cross-sectional defects which affect structural strength. ●Severe scouring in the upstream and downstream, subsidence/runoff of many parts of revetment works.	●Cross-sectional defects which affect structural strength. ●Failure to open and close the gate.	●Cross-sectional defects which affect structural strength.		D	●The function of the weir is impaired and repair, renewal, or other countermeasures are required.			D	●The function of the weir is impaired and repair, renewal, or other countermeasures are required.

*1 Since there are movable weirs (steel gate structures, rubberized cloth structures, etc.) and fixed weirs (concrete structures, rooted block structures, etc.), the function of the weirs will be evaluated according to the classification of the structure.

*2 The condition of the riverbed upstream and downstream will be evaluated by periodic longitudinal and cross-section surveys of the river.

6 Other Structures

6.1 Inspection items

Inspection items related to optical cables laid in the levee are set as other structures. If telecommunications facilities and machinery equipments are included, the inspection items shall be set in coordination with their inspections.

Table 3.8 Inspection items for optical cables

Location or type of work	Inspection items
Other Structures	・ Are there any scouring or deformation in the pipelines and handholes installed for laying optical cables that may affect the function of optical cables?

* For inspections of machinery equipments and telecommunications facilities, refer to "Standard Guidelines for Inspection and Maintenance of River Gate Facilities (Draft), March 2016", "Standard Guidelines for Inspection and Maintenance of River Pump Facilities (Draft), March 2016", and "Inspection Standards for Telecommunications Facilities (Draft), November 2016".

6.2 Evaluation items

For the criteria for evaluating inspection results at each deformation of optical cables, followings shall be applied: the criteria for each structure in “II. Inspection and Evaluation of Levees” and “III. Inspection and Evaluation of River Structures (including levee around structures)”, separate separate guidelines for inspections of machinery equipments, inspections of telecommunications facilities, etc.

Ⅳ. Inspection and evaluation of river channels

1 Purpose

The basics to ascertain the discharge capacity of river channels is to calculate the water level using the results of the periodic river longitudinal and cross-sectional surveys, aerial photogrammetry, riverbed material surveys, vegetation surveys, etc. To ascertain the status of riverbed degradation and riverbank erosion and scouring, that may interfere with the function of river structures such as levees, river crossing structures (weirs etc.), and revetments, it is also basic to conduct evaluation by using information such as the periodic river longitudinal and cross-sectional surveys, historical information such as floods, etc.

The Guidelines summarize the visual inspection, that should be conducted to ascertain the change of the river channel that may affect its discharge capacity and the functional and structural stability of the river structures in areas that require attention as identified by assessments of the condition based on periodic river cross section maps, etc. and river works (riverbed excavation etc.) conducted in recent years.

2 Inspection items

The status of changes will be inspected in the following places and areas: i) Areas of concern that can be assumed from riverbed changes based on longitudinal and cross-sectional survey results over the years, and changes in trees and waterways that can be grasped from aerial photographs, etc., and ii) Areas of river construction such as riverbed excavation carried out in recent years. Depending on the width of the river, the range in which visual inspection can be performed may be limited, but if the conditions of the river channel change significantly, the implementation of a detailed survey should be considered.

Table 4.1 Inspection items for river channels

Area	Inspection items
Discharge capacity	・ Is there any sediment accumulation, such as riverbed rise, that obstructs the flow section of the river channel? ・ In the section where the low-water channel was widened, is there a reduction in the width of the river due to re-sedimentation? ・ Is there overgrowth of trees that obstructs the flood flow? ・ Is there any decrease in the cross-section area of the river channel caused by driftwood etc.?
Riverbed degradation	・ Is there any deformation (subsidence etc.) in the structure as a sign of riverbed degradation or local scouring?
Riverbank erosion	・ Is there a collapse or erosion on the natural riverbank? Has the riverbank alignment* crossed the levee protection line or low-water channel riverbank management line into the levee side? ・ Is there any drift current (water colliding/scouring) due to overgrowth of trees?
River mouth closure	・ Is there a river mouth closure or an increase in the river-mouth sandbar height?

*Riverbank alignment means plane position of the shoulder of the low-water channel.

3 Evaluation items

Since the evaluation of the discharge capacity is basically carried out by calculating the water level, visual inspection at the site is a supplementary matter. It is also necessary to evaluate the width of the river, the flow section, the longitudinal slope, etc., and the evaluation items such as sediment accumulation and tree overgrowth are at the study stage. Since it is basic to evaluate the riverbed

degradation, erosion and scouring of the riverbank, and the river mouth closure based on information over time such as periodic longitudinal surveys of rivers, visual inspections at the site are supplementary matters. These evaluation items are also in the study stage and will be determined after accumulating disaster information and technical knowledge in the future.

Appendix: Recording Format for Inspection and Evaluation Results

The standard format for recording the inspection and evaluation results of each facility is as follows.

■ Levees (earthen levee, revetment, steel sheet pile revetment, special levee, storm surge levee)

Format 1	Summary Table
Format 2	Individual Slip for Each Deformation
Format 3	Format for Additional Photographs

■ Sluiceways

Format 1	Summary Table
Format 2	Individual Slip for Each Facility
Format 3	Format for Photographs Taken at Each Deformation

■ Sluice Gates

Format 1	Summary Table
Format 2	Individual Slip for Each Facility
Format 3	Format for Photographs Taken at Each Deformation

■ Weirs

Format 1	Summary Table
Format 2	Individual Slip for Each Facility
Format 3	Format for Photographs Taken at Each Deformation

* Format 3 of sluice gates and weirs shall be in the same format as the format 3 for sluiceways.

Recording Format for Inspection and Evaluation Results of Levees (earthen levee, revetment, steel sheet pile revetment, special levee, storm surge levee) **Format 1**

Regional Bureau	Office	River system	River	Riverbank	Section	Kilometer post	Category	Earthen Levee (1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	Other	Sub total	Evaluation	Revetment (13)	(14)	(15)	(16)	Other	Sub total	Evaluation	Special levees and storm surge (17)	(18)	Other	Sub total	Evaluation	Steel sheet pile revetment (19)	(20)	(21)	(22)	(23)	Other	Sub total	Evaluation	Total	Comprehensive Evaluation Evaluation	Reason for evaluation
[Regional Bureau name]	[Office name]	[River system name]	[River name]	Left	1	0.000km +000 - 7.000km +000	b	3	1		1	2				1	2	13		1	24																								
						Left bank L = 7.00 km	c	2									4	1			7	A						A					A										A	7	A	
							d																																					
					2	7.000km +000 - 12.000km +000	b																																							
						Left bank L = 5.00 km	c															-						-					-				-						-	-	
						*mountainous section	d																																						
					3	12.000km +000 - 20.000km +000	b	1	1			1					20	15		2	40					1	1																43		
						Left bank L = 8.00 km	c										12	2		1	15	B					B					B				-							15	B	
							d																																					
					4	20.000km +000 - 30.000km +000	b									1					1																						1		
						Left bank L = 10.00 km	c	1									1				2	C						-					-				-						-	2	C	
						5.0km of this section is mountainous	d																																						
					5	30.000km +000 - 40.000km +000	b																																						
						Left bank L = 10.00 km	c															A						A					-				-							A	
							d																																					
				Right	1	0.000km +000 - 7.000km +000	b																																						
						Left bank L = 7.00 km	c															A						-					-				-							A	
							d																																					
					2	7.000km +000 - 12.000km +000	b																				1				1					1								2		
						Left bank L = 5.00 km	c															A						B					B				C		1		1		2	C	2	C	
						3.0km of this section is mountainous	d																																						
					3	12.000km +000 - 20.000km +000	b																																						
						Left bank L = 8.00 km	c															A							1				1	C				-						-	1	C	
							d																																					
					4	20.000km +000 - 30.000km +000	b			1											1																						1		
						Left bank L = 10.00 km	c															B						A					-				-							B	
							d																																					
					5	30.000km +000 - 35.000km +000	b																				1				1													1		
						Left bank L = 5.00 km	c															A						B					-				-							B	
							d																																					
Total for this river						Left bank L = 40.00 km	b	4	2	1	1	3				2	22	28		3	66			2		1	3				2	1		3										72		
						Right bank L = 35.00 km	c	3									17	3		1	24				1		1									1		1		2			27		
						Middle bank L = 0.00 km	d																																							
						Total L = 75.00 km																																								
Subtotal								7	2	1	1	3				2	39	31		4	90			2	1	1	4			2	1		3			1		1		2		99		

*Enter the number of deformation areas in the b, c, and d fields. The '-' in the evaluation column indicates that the item is not subject to evaluation; do not leave this field blank.

- Evaluation items for earthern levee: [1] crack, [2] cave-ins and euneven terrain, [3] slope collapse, [4] subsidence, [5] deformation of levee foot protector, [6] protrusion, [7] steepening slope, [8] holes for small animals, [9] poor drainage, [10] tree invasion, [11] erosion and vegetation abnormalities, and [12] water leakage and sand boil.
- Evaluation items for revetment: [13] damage to revetments and coverings, [14] protrusion, [15] scouring of the foundation, and [16] edge erosion.
- Evaluation items for special levees and storm surge levees: [17] damage to the main body, and [18] joint deformation, break.
- Evaluation items for steel sheet pile revetment: [19] deformation, protrusion and breakage of steel sheet piles, [20] corrosion of steel sheet piles (rust, holes, reduced wall thickness), [21] opening and missing steel sheet pile joints, [22] subsidence and cave-in of the ground behind, and [23] deformation and damage of cap concrete.

Recording Format for Inspection and Evaluation Results of Levees, Revetments, and Steel Sheet Pile Revetments **Format 2**

[Office name]

Inspection No.		Inspector	[Inspector's name and affiliation]					Date of inspection	[MM/DD/YEAR]
River system	[River system name]	River	[River name]	Riverbank		Kilometer post	xx km + xx m	Address	

Inspection Result

Inspection item	Inspection area	Inspection points	Scale of deformation (meters)				Evaluation		Repairs, detailed inspections, and other related
			Direction (shape)*	Length (L)	Width (B)	Height (H)	No.	Rank	
Status and other matters (Special notes)									

*Direction (shape) should only be filled in for [1] crack (longitudinal, transverse, reticulated, etc.)

Location Map, Schematic Diagram, Photographs, etc.

Location map, schematic diagram, overall photograph, etc.

Comments (Overall photograph, etc.)

Location map, schematic diagram, close-up photograph, etc.

Comments (Close-up photograph, etc.)

Inspection history for the same location

Inspection No.	Date of inspection	Deformation items	Scale of the deformation (meters)				Evaluation	
			Direction (shape)	L	B	H	No.	Rank

Recording Format for Inspection and Evaluation Results of Levees, Revetments, and Steel Sheet Pile Revetments **Format 3**

Inspection No.		Inspector	[Inspector's name and affiliation]					Date of inspection	
River system	[River system name]	River	[River name]	Riverbank		Kilometer post		Address	

Supplementary photographs

Comments	Comments
Comments	Comments
Comments	Comments

Recording Format for Inspection and Evaluation Results of Sluiceways **Format 1**

No.	Date of inspection	Facility name	Installation year	Address	River system	River	River bank	Kilometer post	Body structure	Foundation type	Gate size (m^2)	Evaluation for each part																						Comprehensive Evaluation				
												Levees around the structure						Box		Box coupling		Gatepost		Battlement		Wing wall		Gate operation floor, operation		Approach revetment		Others		Comprehensive Evaluation (structure)				Findings
												Crest		Front slope		Back slope																		Civil engineering facility	Mechanical equipment	Telecommunication facility		
												Deformation	Category	Deformation	Category	Deformation	Category	Deformation	Category	Deformation	Category	Deformation	Category	Deformation	Category	Deformation	Category	Deformation	Category	Deformation	Category	Deformation	Category					
1	[MM/DD/YEAR]	xxxx	2010	xxxx	xx river	xx river	Left	xx km + xx m	flexible structure	Spread foundation	2.3	[2]	c	-	a	-	a	-	a	-	a	-	a	-	a	-	a	-	a	-	a	-	a	C	B	A	C	An uplift has been observed on the crest of the levee. As the assessment of the civil engineering facility indicates a more severe condition compared to that of mechanical and telecommunications equipment, priority is given to the evaluation of the civil engineering facility, with the
2	[MM/DD/YEAR]	xxxx	2000	xxxx	xx river	xx river	Left	xx km + xx m	flexible structure	Spread foundation	6.3	-	a	-	a	-	a	-	a	-	a	-	a	-	a	-	a	-	a	-	a	-	a	A	B	A	B	No deformations have been identified in the civil engineering facility. As the assessment of mechanical equipment is more severe, priority is given to the mechanical equipment assessment, with the comprehensive evaluation rated as B.
3	[MM/DD/YEAR]	xxxx	1990	xxxx	xx river	xx river	Right	xx km + xx m	flexible structure	Soil stabilization	9.0	-	a	-	a	-	a	-	a	[4]	b	-	a	-	a	-	a	-	a	-	a	-	a	B	A	A	B	An opening has been observed at the box joint. The opening is less than 7 cm, and monitoring will continue. Comparing the assessments of mechanical equipment and telecommunications facilities, priority is given to the assessment of the civil engineering facility, which is rated as B.
4	[MM/DD/YEAR]	xxxx	1980	xxxx	xx river	xx river	Right	xx km + xx m	solid structure	Pile foundation	15.0	-	a	-	a	-	a	-	a	[4]	d	-	a	-	a	-	a	-	a	-	a	-	a	C	A	A	C	Brakings were observed at the box joints. As emergency measures were implemented immediately following confirmation of the deformation, the civil engineering facility is rated as C. The overall facility rating prioritised the assessment of the civil engineering facility.

*Deformation and Category shall describe the most severe deformations observed in each part of Format 2.

Recording Format for Inspection and Evaluation Results of Sluiceways **Format 2**

No. xx

Name	xx Sluiceway	River system	xx River	River	xx River	Administrator	xx Office	Date of inspection	[MM/DD/YEAR]	Inspection history	[MM/DD/YEAR]
Address	xxxx	Riverbank	Light	Kilometer post	xx km + xx m		xx Branch Office	Inspector	[Inspector's name and affiliation]		

Facility Overview																				
Installation year	2010	Purpose of installation	Intake, drainage, etc.	Body structure	flexible structure	Foundation type	Spread foundation	Box type	PC box	Tidal area	Within tidal area									
Joint type	Flexible joint	Utilization of the levee crown	For river management only	Landuse in protected area	Houses															
Box size	Box 1	Cross-section	H 1.50 m x B 1.50 m x L 15.00 m x 1 series of gate(s)			Span arrangement	5	Gate area	2.3	m^2	Gate area total	2.3	m^2	Gate type	Slide gate etc.	Foundation height	T.P.+xx	m		
	Box 2*	Cross-section	H - m x B - m x L - m x - series of gate(s)			Span arrangement	-	Gate area	-	m^2				Gate type	-					
	Box 3*	Cross-section	H - m x B - m x L - m x - series of gate(s)			Span arrangement	-	Gate area	-	m^2				Gate type	-					

*To be completed when multiple cross-sectional shapes and gate types exist. If four or more cross-sectional shapes exist for the box, add the area of the fourth box to the total gate area and note this under "Others".

Evaluation of each part

Part			Deformation item	Scale of deformation (meters) Direction	Length L	Width B	Height H	Evaluation Deformation	Category	Findings in each deformation	Countermeasures such as repairs and detailed inspections	Photo No.
1	Levees around the structure	Crest	7 Lifting	-	-	-	0.25	[2]	c	An uplift approximately 25 cm in height is observed, which is assessed as 'c'.	Detailed inspection required	1,2
			- -	-			-	-	-			
			- -	-			-	-	-			
		Front slope	- -	-	-	-	-	-	a		-	
			- -	-				-	-			
			- -	-				-	-			
		Back slope	- -	-	-	-	-	-	a		-	
			- -	-				-	-			
			- -	-				-	-			
2	Box		- -	-	-	-	-	-	a	Due to its small calibre, internal inspection is required.	-	3,4
			- -	-				-	-			
			- -	-				-	-			
3	Box coupling		- -	-	-	-	-	-	a		-	
			- -	-				-	-			
			- -	-				-	-			
4	Gatepost		- -	-	-	-	-	-	a		-	
			- -	-				-	-			
			- -	-				-	-			
5	Battlement		- -	-	-	-	-	-	a		-	
			- -	-				-	-			
			- -	-				-	-			
6	Wing wall		- -	-	-	-	-	-	a		-	
			- -	-				-	-			
			- -	-				-	-			
7	Gate operation floor, operation room		- -	-	-	-	-	-	a		-	
			- -	-				-	-			
			- -	-				-	-			
8	Approach revetment		- -	-	-	-	-	-	a		-	
			- -	-				-	-			
			- -	-				-	-			
9	Others		- -	-	-	-	-	-	a		-	
			- -	-				-	-			
			- -	-				-	-			
Evaluation of civil engineering facility			Findings: An uplift has been observed on the crest of the levee. In the box, due to its small calibre, visual confirmation is difficult. Subsidence of the surrounding ground is anticipated, necessitating confirmation through detailed inspection. Therefore, it is assessed as 'c'.						C			

*For each part, record the most severe deformation from the top. Photographs illustrating each deformation should be included in Format 3.

Comprehensive Evaluation

Comprehensive Evaluation (structure) CEF*1	ME*2	TF*3		Findings
C	B	A	C	In the civil engineering structure, an uplift has been observed on the crest of the levee. As the assessment of civil engineering structures indicates a more severe condition compared to that of mechanical and telecommunications equipment, priority is given to the evaluation of civil engineering structures, with the facility assessment rated as C.

*1 CEF: Civil engineering facility, *2 ME: Mechanical equipment, *3 TF: Telecommunication facility

The comprehensive evaluation for the entire sluiceway shall be determined and recorded based on a comprehensive assessment, including the evaluation results of mechanical equipments and telecommunications facilities.

Basic information (Location map, overall photograph, drawing, etc.)

Location map, etc.

Comments

Overall photograph, etc.

Comments

Others (Comparison with inspection history, repair history, etc.)

*Attach location maps, overall photographs, drawings, etc.

Format 3

Name	xxxx Sluiceway	River system	xx River	River	xx River

Photographs

Photograph No. 1

Distant view photopgaph	Close-up photograph
Title (overall status etc.)	Title (close-up status etc.)

Status etc.

Photograph No. 2

Distant view photopgaph	Close-up photograph
Title (overall status etc.)	Title (close-up status etc.)

Status etc.

Photograph No. 3

Distant view photopgaph	Close-up photograph
Title (overall status etc.)	Title (close-up status etc.)

Status etc.

Recording Format for Inspection and Evaluation Results of Sluice Gates **Format 1**

No.	Date of inspection	Facility name	Installation year	Address	River system	River	River bank	Kilometer post	Foundation type	Gate size (m^2)	Evaluation for each part																								Comprehensive Evaluation				
											Levees around the structure						Floor slabs, apron		Weir columns		Gate posts		Gate operation floor, operation		Battlement		Wing wall		Approach revetment		Revetment works		Others		Comprehensive Evaluation (structure				Findings
											Crest		Front slope		Back slope																							
											Deformation	Category	Deformation	Category	Deformation	Category	Deformation	Category	Deformation	Category	Deformation	Category	Deformation	Category	Deformation	Category	Deformation	Category	Deformation	Category	Deformation	Category	Deformation	Category	Civil engineering facility	Mechanical equipment	Telecommunication facility		
1	[MM/DD/YEAR]	xxxx	2017	xxxx	xx river	xx river	xx	xx km + xx m	Spread foundation	5.3	-	a	-	a	-	a	[2]	c	-	a	-	a	-	a	-	a	-	a	-	a	-	a	-	a	C	B	A	C	Progressive cracking has been observed in the civil engineering facility, indicating that it has reached the stage where preventive maintenance is required. Priority is given to the evaluation of civil engineering facility, with the comprehensive evaluation rated as C.
2	[MM/DD/YEAR]	xxxx	2017	xxxx	xx river	xx river	xx	xx km + xx m	Pile foundation	9.0	-	a	-	a	-	a	-	a	[4]	b	-	a	-	a	-	a	-	a	-	a	-	a	-	a	B	A	A	B	Cracks are visible in the weir column. Monitor the progression of cracks and assign a B rating to the civil engineering facility. As there are no abnormalities in the mechanical equipment or telecommunications facilities, the comprehensive evaluation is rated B.
3	[MM/DD/YEAR]	xxxx	2017	xxxx	xx river	xx river	xx	xx km + xx m	Soil stabilization	12.3	-	a	-	a	-	a	-	a	-	a	-	a	-	a	-	a	-	a	-	a	-	a	-	a	A	A	A	A	No abnormalities were detected.

*Deformation and Category shall describe the most severe deformations observed in each part of Format 2.

Recording Format for Inspection and Evaluation Results of Sluice Gates **Format 2**

No. xx

Name	xx Sluiceway	River system	xx River	River	xx River	Administrator	xx Office	Date of inspection	[MM/DD/YEAR]	Inspection history	[MM/DD/YEAR]
Address		Riverbank	Light	Kilometer post	xx km + xx m		xx Branch Office	Inspector	[Inspector's name and affiliation]		

Facility Overview	Installation year	2017	Purpose of installation	Backflow prevention		Foundation type	Spread foundation	Water transportation [Y/N]	Y	Utilization of the bridge for management		For river management only	Landuse in protected area	Houses		Tidal area	Within tidal area	
	Body size	Body 1	Cross-section	H 2.30 m x B 2.30 m x L 15.00 m x 1 gate(s)				Gate area		5.3	m^2	Gate area total	5.3 m^2	Gate type	Roller gate etc.		Foundation height	T.P.+xx m
		Body 2*	Cross-section	H - m x B - m x L - m x - gate(s)				Gate area		-	m^2			Gate type	-			
		Body 3*	Cross-section	H - m x B - m x L - m x - gate(s)				Gate area		-	m^2			Gate type	-			

*To be completed when multiple cross-sectional shapes and gate types exist. If four or more cross-sectional shapes exist for the box, add the area of the fourth box to the total gate area and note this under "Others".

Evaluation of each part

Part			Deformation item	Scale of deformation (meters) Direction	Length L	Width B	Height H	Evaluation Deformation	Category	Findings in each deformation	Countermeasures such as repairs and detailed inspections	Photo No.
1	Levees around the structure	Crest	- -	-	-	-	-	-	a		-	
			- -	-			-	-	-			
		Front slope	- -	-	-	-	-	-	a		-	
			- -	-				-	-			
		Back slope	- -	-	-	-	-	-	a		-	
			- -	-				-	-			
2	Floor slabs, apron		1 Cracks	-	-	-	-	[2]	c	A crack has been identified in the apron, which has expanded since the previous inspection record. Therefore, it is rated as c.	-	
			- -	-				-	-			
			- -	-				-	-			
3	Weir columns		- -	-	-	-	-	-	a		-	
			- -	-				-	-			
			- -	-				-	-			
4	Gatepost		- -	-	-	-	-	-	a		-	
			- -	-				-	-			
			- -	-				-	-			
5	Gate operation floor, operation room		- -	-	-	-	-	-	a		-	
			- -	-				-	-			
			- -	-				-	-			
6	Battlement		- -	-	-	-	-	-	a		-	
			- -	-				-	-			
			- -	-				-	-			
7	Wing wall		- -	-	-	-	-	-	a		-	
			- -	-				-	-			
			- -	-				-	-			
8	Approach revetment		- -	-	-	-	-	-	a		-	
			- -	-				-	-			
			- -	-				-	-			
9	Revetment works		- -	-	-	-	-	-	a		-	
			- -	-				-	-			
			- -	-				-	-			
10	Others		- -	-	-	-	-	-	a		-	
			- -	-				-	-			
			- -	-				-	-			
Evaluation of civil engineering facility			Findings	The crack in the apron has widened since the previous inspection and is progressing, hence a C rating is assigned. No other significant deformations were observed in other parts.					C			

*For each part, record the most severe deformation from the top. Photographs illustrating each deformation should be included in Format 3.

Basic information (Location map, overall photograph, drawing, etc.)

Location map, etc.

Comments

Overall photograph, etc.

Comments

Others (Comparison with inspection history, repair history, etc.)

*Attach location maps, overall photographs, drawings, etc.

Comprehensive Evaluation

Comprehensive Evaluation (structure) CEF*1	ME*2	TF*3		Findings
C	B	A	C	A progressive crack has been observed in the civil engineering facility, indicating that it has reached the stage where preventive maintenance is required. Priority is given to the evaluation of civil engineering facility, with the comprehensive evaluation rated as C.

*1 CEF: Civil engineering facility, *2 ME: Mechanical equipment, *3 TF: Telecommunication facility

The comprehensive evaluation for the entire sluiceway shall be determined and recorded based on a comprehensive assessment, including the evaluation results of mechanical equipments and telecommunications facilities.

Recording Format for Inspection and Evaluation Results of Weirs **Format 1**

No.	Date of inspection	Facility name	Installation year	Address	River system	River	Kilometer post	Weir type	Foundation type	Weir length	Evaluation for each part																								Comprehensive Evaluation					
											Floor slabs, apron		Weir columns		Gateposts		Gate operation floor, operation		Revetment works		Fishways		Flushing gates		Locks		Approach revetment		Intake		Upstream riverbed		Downstream riverbed		Others		Comprehensive Evaluation (structure)				Findings
											Deformation	Category	Deformation	Category	Deformation	Category	Deformation	Category	Deformation	Category	Deformation	Category	Deformation	Category	Deformation	Category	Deformation	Category	Deformation	Category	Deformation	Category	Deformation	Category	Deformation	Category	Civil engineering facility	Mechanical equipment	Telecommunication facility		
1	[MM/DD/YEAR]	xxxx	2010	xxxx	xx river	xx river	xx km + xx m	Movable weir	Spread foundation	50m	-	a	-	a	-	a	-	a	-	a	-	a	-	a	-	a	-	a	-	a	-	a	[1]	c	-	a	C	B	A	C	In civil engineering structures, the downstream riverbed is subsiding. As the assessment of the civil engineering facility indicates a more severe condition compared to that of mechanical and telecommunications equipment, priority is given to the evaluation of the civil engineering facility, with the comprehensive evaluation rated as C.
2	[MM/DD/YEAR]	xxxx	2010	xxxx	xx river	xx river	xx km + xx m	Movable weir	Pile foundation	100m	-	a	-	a	[2]	b	-	a	-	a	-	a	-	a	-	a	-	a	-	a	-	a	-	a	-	a	B	A	A	B	Cracks are visible in the weir column. Monitor the progression of cracks and assign a B rating to the civil engineering facility. As there are no abnormalities in the mechanical equipment or telecommunications facilities, the comprehensive evaluation is rated B.
3	[MM/DD/YEAR]	xxxx	2010	xxxx	xx river	xx river	xx km + xx m	Moverble and fixed weir	Soil stabilization	150m	-	a	-	a	-	a	-	a	-	a	-	a	-	a	-	a	-	a	-	a	-	a	-	a	-	a	A	A	A	A	No abnormalities were detected.

*Deformation and Category shall describe the most severe deformations observed in each part of Format 2.

Recording Format for Inspection and Evaluation Results of Weirs **Format 2**

No. xx

Name	xx Sluiceway	River system	xx River	River	xx River	Administrator	xx Office	Date of inspection	[MM/DD/YEAR]	Inspection history	[MM/DD/YEAR]
Address	xxxx			Kilometer post	xx km + xx m		xx Branch Office	Inspector	[Inspector's name and affiliation]		

Facility Overview	Installation year	2010	Purpose of installation	Final baffling		Weir type	Movable weir	Foundation type	Spread foundation		Tidal area	Within tidal area	Fishways [Y/N]	Y	Flushing gates [Y/N]	Y	Locks [Y/N]	Y		
	Body length (cross-channel direction)										Movable section (Spillway section)									
	Total lengh	50 m		Fixed section length	xx m		Movable section length	xx m			Number of gates	xx gates	Total door area	xx m^2		Type	Lift gate (normal)			

Evaluation of each part

Part		Deformation item	Scale of deformation (meters) Direction	Length L	Width B	Height H	Evaluation Deformation	Category	Findings in each deformation	Countermeasures such as repairs and detailed inspections	Photo No.
1	Floor slabs, apron	- -	-	-	-	-	-	-		-	
		- -	-			-	-	-			
		- -	-	-	-	-	-	-			
2	Weir columns	- -	-				-	-		-	
		- -	-	-	-	-	-	-			
		- -	-				-	-			
3	Gateposts	- -	-	-	-	-	-	-		-	
		- -	-				-	-			
		- -	-				-	-			
4	Gate operation floor, operation room	- -	-	-	-	-	-	-		-	
		- -	-				-	-			
		- -	-				-	-			
5	Revetment works	- -	-	-	-	-	-	-		-	
		- -	-				-	-			
		- -	-				-	-			
6	Fishways	- -	-	-	-	-	-	-		-	
		- -	-				-	-			
		- -	-				-	-			
7	Flushing gates	- -	-	-	-	-	-	-		-	
		- -	-				-	-			
		- -	-				-	-			
8	Locks	- -	-	-	-	-	-	-		-	
		- -	-				-	-			
		- -	-				-	-			
9	Approach revetment	- -	-	-	-	-	-	-		-	
		- -	-				-	-			
		- -	-				-	-			
10	Intake	- -	-	-	-	-	-	-		-	
		- -	-				-	-			
		- -	-				-	-			
11	Upstream riverbed	- -	-	-	-	-	-	-		-	
		- -	-				-	-			
		- -	-				-	-			
12	Downstream riverbed	1 Scouring of riverbeds	-	-	-	-	[1]	c	Due to the significant riverbed scouring, it is rated as c.	-	
		- -	-				-	-			
		- -	-				-	-			
13	Others	- -	-	-	-	-	-	-		-	
		- -	-				-	-			
		- -	-				-	-			
Evaluation of civil engineering facility		Findings: The crack in the apron has widened since the previous inspection and is progressing, hence a Crating is assigned. No other significant deformations were observed in other parts.						C			

*For each part, record the most severe deformation from the top. Photographs illustrating each deformation should be included in Format 3.

Comprehensive Evaluation

Comprehensive Evaluation (structure) CEF*1	ME*2	TF*3		Findings
C	B	A	C	In civil engineering structures, the downstream riverbed is subsiding. As the assessment of the civil engineering facility indicates a more severe condition compared to that of mechanical and telecommunications equipment, priority is given to the evaluation of the civil engineering facility, with the comprehensive evaluation rated as C.

*1 CEF: Civil engineering facility, *2 ME: Mechanical equipment, *3 TF: Telecommunication facility

The comprehensive evaluation for the entire sluiceway shall be determined and recorded based on a comprehensive assessment, including the evaluation results of mechanical equipments and telecommunications facilities.

Basic information (Location map, overall photograph, drawing, etc.)

Location map, etc.

Comments

Overall photograph, etc.

Comments

Others (Comparison with inspection history, repair history, etc.)

*Attach location maps, overall photographs, drawings, etc.