PORT HOUSTON
Maritime Facilities Inspection and Condition Assessment Manual

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CHAPTER 1: INTRODUCTION

1.1. General

Port Houston is a 25-mile-long complex of 150-plus private and public industrial terminals along the 52-mile-long Houston Ship Channel. As of 2016, more than 200 million tons of cargo move through the greater port of Houston each year, carried by more than 8,000 vessels and 200,000 barges.

Eight of the public terminals within Port Houston are owned, managed, and/or leased by the Port of Houston Authority (PHA) and include a wide variety of maritime assets. These maritime assets consist of cargo wharves; barge landing areas; small boat docks (fireboats and tour boat); bulkhead (unassociated with docks); riprap shoreline; and one vehicle bridge. These assets serve a variety of purposes, including: handling of bulk materials, liquids, and containers; boat landing areas; boat docks; bulkheads for soil retention; and vehicle traffic. The age of these assets range from a few years to more than 100 years old, and they have been constructed with a wide range of structural systems and materials. A complete list of PHA maritime assets is provided in Appendix A.

This Maritime Facilities Inspection and Condition Assessment Manual (FICAP Manual) defines the requirements, documentation, and reporting for inspection and condition assessments, of maritime assets at facilities owned or operated by the PHA. The inspection and condition assessment of assets is an essential part of asset management for any public or private infrastructure owner, as it provides the information necessary to:

- Define the condition of an asset at a point in time. This may be used for various purposes, including to define value, monitor ongoing deterioration or damage over time (when inspections are conducted at regular intervals), or to define baseline conditions for legal purposes such as change of ownership.
- Identify conditions that may compromise facility operations due to complete or partial structural failure leading to loss of functionality.
- Identify conditions that may lead to property or environmental damage.
- Evaluate the functional adequacy of the asset in terms of load rating and specific uses.
- Assess conditions that require maintenance, repair, or replacement to maintain or extend the useful service life of the facility.
- Program work in terms of allocating funds and assigning priorities.

The objective of the maritime facility inspection and condition assessment program is to provide a uniform guideline for inspection teams to carry out baseline and routine (structural) visual inspections and condition assessments of the maritime assets owned by Port of Houston Authority (PHA). Furthermore the objective of this program is to provide inspection and assessment information appropriate for the use by PHA Asset Management, Project and Construction Management, and Maintenance Departments to determine need and timing of some preventative or remedial action to maintain the desired level of service.

Numerous challenges exist in making effective and consistent inspections and assessments, including the wide variety of facility types, structural systems, and exposure conditions, as well as the various training, experience, and practices of engineers and inspectors conducting the inspection and assessments. Without a standardized approach meeting the PHA's specific asset management needs, these challenges can result in disparate inspection findings and condition documentation across the entire maritime facility inventory.

The goal of this Manual is to define the process, procedures, and requirements for completing inspections and condition assessments for maritime assets in a consistent manner and level of detail to meet the needs of the PHA. The Manual is intended to be used by qualified professional engineers and inspectors. An Inspection and Condition Assessment Training Course offered by PHA supplements this Manual and is intended to aid engineers, inspectors and facility managers in its use. Completion of the Training Course and adherence to the requirements of this Manual are required for performing inspections and condition assessments for maritime facilities for the Port of Houston Authority.

1.2. Manual Scope

The scope of this Manual includes the engineering requirements for conducting above water and underwater inspections and the associated condition assessment of the structural and non-structural components of the PHA's maritime assets. The Manual does not address specific safety requirements for the Inspection Team, nor does it address diving procedures and safety issues related to underwater inspections.

The scope of the Manual is limited to the following maritime asset types:

- Cargo wharves (bulk, liquid, general cargo, and container)
- T-docks
- Boat and barge docks
- Bulkheads (not associated with wharves)
- Protected and unprotected shoreline
- Rail loading platforms
- Bridges (only those owned and maintained by PHA)

The maritime assets may be comprised of a range of structural and non-structural components. This Manual addresses the following component types:

- Structural components (e.g., deck, superstructure, substructure, bulkhead)
- Berthing components (e.g., fender and mooring systems and hardware (cleats, bollards, and bitts))
- Shoreline components (e.g., unprotected and protected)
- Ancillary or other components (e.g., personal access systems (catwalks, ladders, and fall protection), guards (guardrails and wharf logs), crane tie-downs, crane and train rail supports, tracks and rails, utility systems supports, paints and markings)

The Manual is not intended for use in the inspection and condition assessment of:

- Impressed current or sacrificial anode cathodic protection systems.
- Utilities, such as mechanical, electrical, and plumbing systems, with the exception of their attachment to the asset and general condition of piping or conduits.
- Buildings, sheds, or other similar constructions.
- Mechanical operation of crane and train rails (such as track switches).
- Wharf cranes and other mechanized equipment.
- Security components (such as fences and cameras), with the exception of their attachment to the asset.

1.3. Inspection and Condition Assessment Approach

The terms "inspection" and "condition assessment" refer to different but related activities. An inspection is an evaluation procedure in which a qualified team leader carries out or supervises the observation, classification, and documentation of the physical condition of a maritime asset. It may involve visual, tactile, and nondestructive testing methods, as well as material sampling and testing to determine the types, severity, and locations of deterioration or distress in the asset. A condition assessment is an evaluation of the inspection results considering the significance of observed conditions. A condition assessment is based on engineering judgment considering qualitative and quantitative inspection findings and may be supplemented by engineering calculations. The outcome of a condition assessment is to determine the need and priority of maintenance, repair, or rehabilitation actions for an asset. While this Manual discusses various inspection types and procedures, unless otherwise noted, inspections conducted for the PHA are expected to include condition assessments in the form of both applicable component and overall asset ratings (discussed in the following sections).

The inspection and condition assessment process in this Manual uses an element-based approach. This approach is similar to that used for bridges as developed by AASHTO and presented by Ryan et al. (2012) and AASHTO (2013), and as used for waterfront facilities inspection, including the approach presented in ASCE Manual 130 (ASCE 2015). The general concepts and terms of this element-based approach are explained in the following sections of this chapter. Detailed procedures and guides for implementation are provided in subsequent chapters.

1.3.1. Hierarchy of Terminal and Asset Terminology

The premise of an element-based inspection and condition assessment approach requires the definition of a clear hierarchy extending from the PHA's properties and terminals down to the element level. This Manual uses the hierarchy shown in Figure 1.1, and the terms in this hierarchy are defined below. An example for a hypothetical terminal using this hierarchy is shown in Figure 1.2. Element and component types are discussed in Chapters 3 and 4, respectively. In addition to the terms defined in these chapters, an extensive Glossary of Terms is provided in Appendix B.

Property or Terminal This is the highest level in the hierarchy from an inspection and condition assessment perspective (higher levels may be considered for asset management or other purposes). The property or terminal is typically comprised of a group of assets which taken together comprise a terminal or property. The property or terminal is normally defined by distinct property boundaries. A Terminal is used where the primary assets are a collection of cargo wharves, and a Property is used for other areas.

Maritime Asset Each property or terminal is normally divided into several maritime assets, each of which may serve a separate, similar, or common functional purpose. Asset types may include wharves, boat docks, bulkheads, or shore protection. The boundaries of each asset are determined primarily by asset type, but may be defined based on factors such as functional use, original construction date, logical inventory, or maintenance considerations.

Component Each maritime asset is typically comprised of several components. A component is a group of structural or non-structural elements that make up some part of the overall maritime asset. Typical structural component types include the deck, superstructure, and substructure. Typical non-structural component groups for maritime assets include the fender and mooring systems. The boundaries between component types are dictated by structural or functional purpose within the asset, but may also consider logical distinctions based on changes in structural system or construction material.

Element Each component is comprised of one or more elements. An element is an individual structural or non-structural member. Element types are defined by the component to which it belongs, its structural or functional purpose, geometry, and material. Geometry includes the general shape and orientation of the element. Material for an element is defined generally and can include reinforced concrete, steel, timber, rubber, etc.

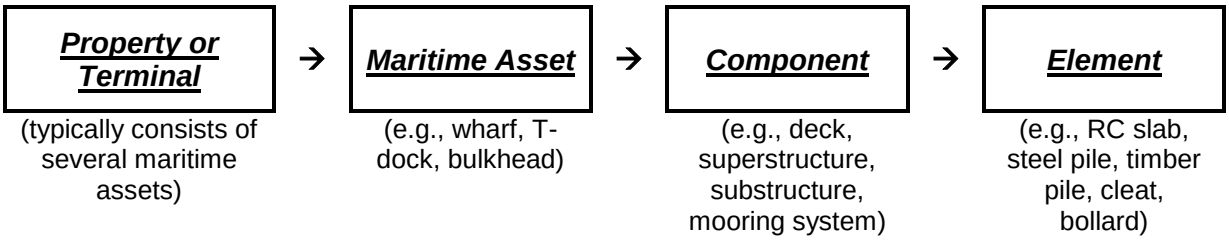


Figure 1.1: Hierarchy of Facility Terms

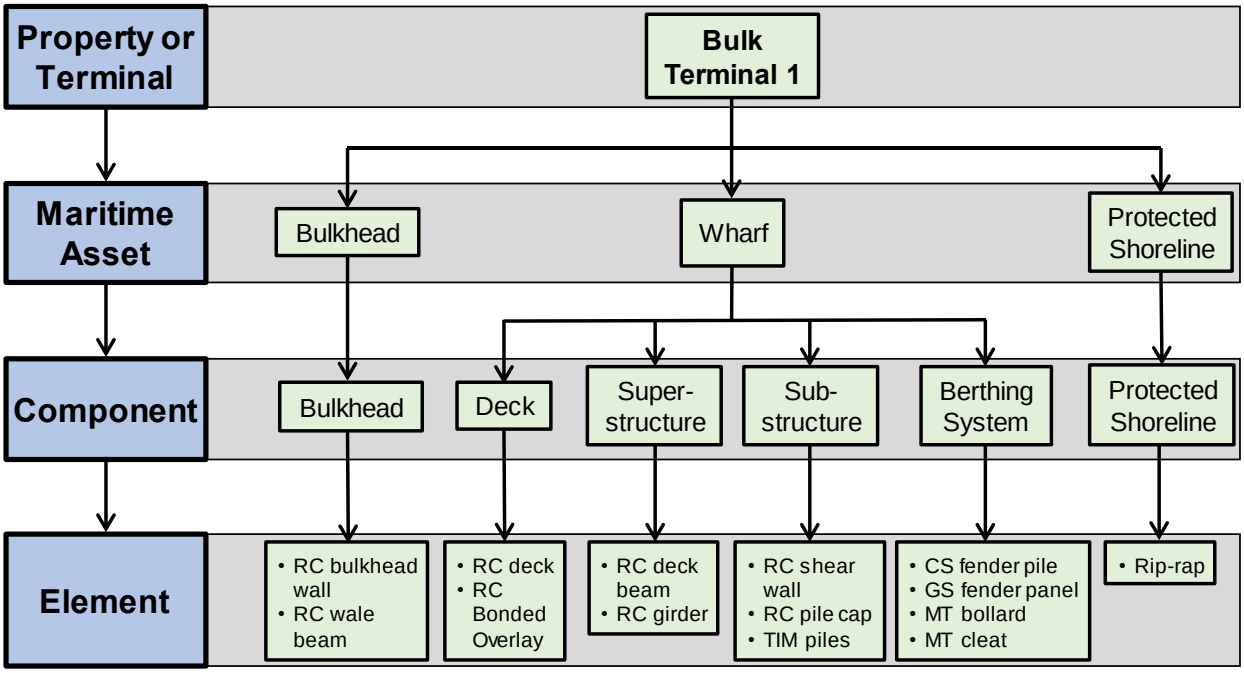


Figure 1.2: Hierarchy Applied to Hypothetical Bulk Terminal

1.3.2. Element-Based Inspection and Condition Assessment Approach

The inspection and condition assessment of an asset is a key component of an asset management program. The credibility of the inspection and condition assessment relies upon two equally important factors: 1) the experience and knowledge of the engineer(s) responsible for the assessment, and 2) the completeness and quality of the observed condition of the asset determined during the inspection. The inspection findings should be observed and documented in a manner that provides the condition information necessary to facilitate a credible condition assessment. Specifically, the inspection findings should be characterized and reported in terms of:

- Types of elements that may have damage, deterioration, or defects (observed conditions). This is needed to assess the overall structural implications of observed conditions. It is generally more effective to characterize conditions according to element type as well.
- Type of observed condition (e.g., structural steel or reinforcement corrosion, concrete spalling, wood decay, impact damage, or wear).
- Severity of observed condition (e.g., type and size of defects, severity of section loss).
- Scope or extent of observed condition (e.g., number of defects, area/length affected).

In order to provide the type and detail of condition information described above, an element-based inspection is necessary. The element-based inspection approach documents the visual condition of each inspected element (e.g., a single slab, beam, pile, or fender with defined extents) of the asset. Element condition states are used to provide a clearly defined indication of the type, severity, and extent of the observed conditions (damage, deterioration, or defects) for a given element. An individual element may exhibit more than one type of condition and may also exhibit different levels of observed conditions on the same element. Accordingly, the element-based inspection requires quantification of each condition type, severity, and extent for a given element. For linear elements such as a beam, conditions are typically quantified by linear dimension (per foot) of the beam's overall length. For planar elements such as slabs and walls, conditions are typically quantified by area dimension (per square foot) of the overall member area. Other elements such as mooring hardware are quantified per unit. In all cases, the element condition states are assigned relative to the as-built or original condition of the element. The definition and use of condition states at the element level improves the objectivity and repeatability of the inspection and condition assessment.

The detailed visual condition information collected through an element-based inspection provides the basis for the condition assessment. The inspection and condition assessment approach defined in this Manual incudes a condition assessment at both the component and asset levels and is described by component ratings and overall asset ratings, respectively. Component ratings indicate the overall condition of a component (e.g., entire deck, superstructure, substructure, mooring system, etc.) and are determined based on engineering interpretation of the inspection findings for the elements that make up the component. The purpose of the component rating is to provide a condition assessment for each structural or non-structural system (component) in an asset for use in assessing the overall condition of the asset and to guide follow-up actions (e.g., need for further inspection, emergency repairs) and prioritize maintenance or repairs. The overall asset condition rating is a condition assessment for the entire asset (group of components) based on the component ratings, and includes a qualitative description of the asset condition. The outcome of the inspection and condition assessment process for a maritime asset is represented by the combination of the overall asset rating along with a qualitative description, the component ratings, and the follow-up actions. The element-based inspection and condition assessment approach and its influence on component and overall asset ratings are summarized in Table 1.1. Element condition states are defined in detail in Chapter

3 of this Manual. The condition assessment approach using component and overall asset ratings is described in Chapter 6 of this Manual.

Table 1.1: Summary of Element-Based Approach

Level	Purpose	Comment
Asset	▪ Overall asset condition assessment guides follow-up actions and asset management decisions.	▪ Overall asset condition is described as a numerical rating and is supplemented by a qualitative (descriptive) assessment.
Component	▪ Component condition assessment indicates condition of structural and non-structural systems in the asset. ▪ Provide basis to determine overall asset condition.	▪ Numerical component rating is based on an engineering interpretation of the element condition states and their corresponding implication(s) on structural and/or functional condition of the component.
Element	▪ Condition states document occurrence of damage, deterioration, or defects at time of inspection in terms of: o Type of condition(s) (i.e. damage mechanism) o Severity of defect (i.e. moderate, severe) o Extent of defect (i.e. localized or general) ▪ Correlates conditions to element and material type. ▪ Tracks conditions over time as indicated by inspections conducted at regular intervals. ▪ Provides basis for component rating.	▪ Detailed visual inspections are conducted at the element level. ▪ Element condition states are assigned based on predefined categories and quantified to define element condition.

1.4. FICAP Overview

Three types of inspections and condition assessments are defined in the PHA FICAP:

Baseline: Inspection to establish asset inventory information and provide a baseline condition assessment for new assets and for existing assets where no previous inspection exists.

Routine: Regularly-scheduled inspection to define asset condition at a point in time.

Special: Inspection in response to specific situations, including Post-event Inspection to assess condition after an extreme event (e.g., hurricane, vessel impact); Due Diligence Inspection to assess condition at times of change of ownership, lease, insurance, etc.; and In-Depth Inspection to determine the cause and significance of damage or deterioration and to provide the condition information necessary to complete designs for repair and/or strengthening.

The primary aspects of the FICAP are the Baseline and Routine Inspections. Implementation of the Program involves conducting a Baseline Inspection of each maritime asset in the PHA inventory, followed by regularly scheduled Routine Inspections at prescribed intervals to track changes in the asset's condition over time. In the event that the conditions observed during a Baseline or Routine Inspection require further information or indicate that repairs may be required, an In-Depth Inspection (with a specific scope defined by the PHA based on inspection results and the PHA's operational priorities) may be conducted. Post-Event and Due Diligence Inspections are conducted as and when needed. Each inspection type is described in detail in Chapter 2 of this Manual.

1.5. Limitations of FICAP Manual

The inspection and condition assessment methodologies presented in the FICAP Manual are subject to the following limitations

- The inspection and condition assessment methodology outlined in this Manual is limited to a visual inspection approach, and does not consider other in-depth inspection methods such as material sampling and coring and non-destructive evaluation techniques including impact echo, impulse response, ultrasonic techniques, ground penetrating radar, radiography, infrared thermography, electrical resistivity, half-cell potentials, corrosion rate measurements, etc.
- This Manual is limited to procedures outlining Baseline and Routine type of visual inspection (see Chapter 2 for inspection types). The Manual does not define procedures or requirements for other inspection types (Post-Event, Due Diligence, or In-Depth Inspections) and engineering analysis.

1.6. Manual Organization

The manual is organized in ten chapters:

- Chapter 1 describes the scope and purpose of the manual and inspection program.
- Chapter 2 describes the inspection types in terms of objectives and scope of work.
- Chapter 3 presents the element types encountered in PHA maritime facilities, and discusses the element condition state descriptions used in this manual.
- Chapter 4 lists the structural and non-structural component types encountered in PHA maritime assets. The component types are presented in five groups based on their structural or functional purpose and considers the condition rating criteria used to assess the component condition.
- Chapter 5 describes the maritime asset types in the PHA inventory.
- Chapter 6 presents the assessment and rating approach used for components and maritime assets.
- Chapter 7 provides guidance on the recommended actions that may arise following an inspection and condition assessment.
- Chapter 8 describes the documentation and reporting requirements for inspections.
- Chapter 9 discusses administrative requirements associated with inspections, including inspection team qualifications, as well as safety, security, and insurance requirements. Limitations and responsibilities are also discussed.
- Chapter 10 lists the references cited in this report, as well as other references suggested to provide relevant background information on inspection and condition assessment of maritime assets.

CHAPTER 2: INSPECTION TYPES

2.1. Type of Inspection and Level of Effort

Given the overall objectives of the inspection and condition assessment program described in Chapter 1, the specific objectives, scope, and level of effort involved in a given inspection and condition assessment type may vary depending on the circumstances of a particular maritime asset. While this chapter discusses various physical inspection types, with the scope of the PHA FICAP and unless otherwise noted, inspections conducted for the PHA are expected to include condition assessments in the form of applicable component and overall asset condition ratings.

2.1.1. Types of Inspection

This Manual defines three general types of inspections and several sub-types to address the range of objectives that may be desired. The inspection types and their associated objectives are summarized in Table 2.1.

Table 2.1: Summary of Inspection Types and Objectives

Inspection Type	Sub-type	Primary Objective
Baseline	Above water	Inspection to establish the baseline (initial) asset inventory information and component and overall asset ratings for a new asset or for an existing asset where no previous record exists.
	Underwater	
Routine	Above water	Regularly-scheduled inspection to define asset condition, component and overall asset ratings, and element condition states at a point in time and to allow tracking of conditions over time.
	Underwater	
Special	Post-event	Rapid response inspection to assess overall condition following an extreme event such as a hurricane, flood, or vessel impact.
	In-Depth	In-depth inspection to determine cause and/or significance of damage or distress, to aid in determining a suitable repair approach, to define quantities necessary for repair purposes, or to provide information required to perform an Engineering Analysis to determine a load-rating or as required for a structural upgrade of the asset.
	Due Diligence	Inspection to establish the general condition, asset value, or need for and approximate cost of repairs, at times of change of ownership, lease, or for insurance purposes.

Since by design each inspection type will typically collect or evaluate different information, the definition of each type also includes a description of the levels of effort involved during the actual inspection. For this Manual, the following levels of effort are defined:

- *Above Water - Visual Inspection*. This is a general examination that may include limited cleaning or debris removal (i.e., sweeping off debris or light scraping to evaluate the condition of an element beneath for observation). Any debris removal or scraping (if necessary) is limited to low levels of effort. Visual examination is from a range of 25 feet or less from the surface inspected or as required to assign appropriate condition states. Artificial lighting may be needed.

- *Underwater - Level I, II, and III Inspections.* These inspection types are defined in ASCE 101 for underwater inspection. In general a Level I inspection is a visual or tactile inspection without removal of marine growth. Level II inspections require partial removal of marine growth on a representative sample of the elements. Level III inspections involve either non-destructive or partially-destructive testing on a representative sample of elements.
- *Underwater - Sonar Imaging.* This type of inspection is a nondestructive technique used to provide a three-dimensional profile of the underwater structure. Data from sonar scans are compiled into three-dimensional representations. Resulting data should be able to distinguish size and spacing of piles, depth and profile of channel slope, and extend from the front of the structure to the first channel side bulkhead. In some cases, diving access may be restricted due to waves, currents, visibility or obstructions in the form of debris or very closely spaced piling, for example. In these cases sonar imaging may be utilized to provide the required inspection information.

Inspection types, recommended frequencies, levels of effort, and scope of inspection are summarized in Table 2.2 below.

Table 2.2. Inspection Descriptions

Inspection Type		Maximum Inspection Interval	Inspection Level of Effort [Note 1]		Scope of Inspection
			Above Water	Underwater	
Baseline		Typically once: ▪ After new construction ▪ To establish the baseline condition of an existing asset (initiates Routine Inspection) ▪ After significant renovations that alter the current asset layout	Visual inspection	Level I diving inspections *or* Sonar imaging of substructure, only if diving access is restricted.	Above water: Entire asset Underwater: ▪ Channel-facing elements: mudline to MHHW [Note 3] ▪ Bulkhead: mudline to MHHW ▪ Other elements: MLLW to MHHW
Routine		3 years for above water and 6 years for underwater for assets in fair to good condition [Note 2]	Visual inspection	Level I diving inspections *or* Sonar imaging of substructure, only if diving access is restricted.	Above water: Entire asset Underwater: ▪ Channel-facing elements: mudline to MHHW [Note 3] ▪ Bulkhead: mudline to MHHW ▪ Other elements: MLLW to MHHW
Special	Post-Event	As needed	Visual inspection	Level I, II, or III inspection in areas of suspected damage. Sonar imaging of substructure if required.	Area of asset affected by event

Inspection Type		Maximum Inspection Interval	Inspection Level of Effort [Note 1]		Scope of Inspection
			Above Water	Underwater	
	In-Depth	As needed	As specified	As specified. Typically involves Levels I, II and III. Sonar imaging of substructure if required by project scope	As defined by objectives
	Due Diligence	As needed	Visual inspection	As specified	Entire asset

Note 1: Underwater inspection levels per ASCE 101

Note 2: Inspection interval for a particular asset is defined by the PHA. Interval may be reduced for assets with significant deterioration or where dictated by the type or priority of use. Interval may be increased for newly constructed assets or for other assets at the discretion of the PHA.

Note 3: See Appendix B – Glossary for definition of water elevations (MHHW, MLLW, etc.)

As each inspection is conducted, the inspection and condition assessment report and associated reporting documents are then added to the asset file. Recommended follow-up actions and associated priority are also reported for facilities management consideration (discussed further in Chapter 7).

2.1.2. Considerations for Level of Effort

Readily accessible elements are those with the following characteristics:

- Exposed to either open water or open atmosphere.
- Do not require removal of overburden or other elements.
- Are not considered confined spaces.
- May be accessed by walking, boat, lift, scaffold, or diving.

If confined spaces are identified, the types of elements in the confined space should be identified. If one or more structurally significant elements can only be inspected from the confined space, a confined space entry may be required during the Baseline and Routine Inspections. The need for the confined space entry should be discussed with the PHA Project Manager.

Some elements may be temporarily obscured by cargo, debris, or similar obstructions. For Routine or Baseline Inspections, these areas may be considered temporarily inaccessible and may be skipped for one inspection cycle, provided that the total percentage of obscured areas does not exceed 10 percent of any component and no significant distress is suspected in the obscured area. These areas should be identified and inspected on the next Routine Inspection cycle.

The Inspection Team may recommend removal of overburden, inspection openings, or other more extensive measures to inspect permanently inaccessible elements for follow-up Special Inspections. These areas should be identified by a project-specific scope.

For some assets, it may become readily apparent during a Baseline or Routine inspection that the above-water portions are in very poor or likely unserviceable condition. For example, this would be the case when an above-water component will be given structural component rating (defined in Table 6.1) of 2 or less or if the overall Asset Condition Rating, as outlined in Section 6.4, will be less than 30. In these circumstances, the above-water inspection may be truncated or the underwater inspection may be deferred. Given the increased level of difficulty and cost associated with underwater inspections, it may be desirable to perform Baseline and Routine underwater inspections after the above-water inspection has been completed. In all cases, PHA approval is required to waive any portion of the above-water or underwater inspection based on observed above-water conditions.

The following sections describe the objective and scope of each inspection and condition assessment type.

2.2. Baseline Inspection

The Baseline Inspection is asset-wide that includes both above water and underwater inspections. At a minimum, a Baseline Inspection is the first inspection for an asset and may be considered as its first routine inspection. The purpose of the Baseline Inspection is to:

- Develop an inventory record to be used as a point of reference for future inspections and condition assessments;
- Identify all components and elements within the scope of the inspection and condition assessment for the asset;
- Identify elements that are inaccessible or have special access requirements, including confined spaces;
- Inspect the readily-accessible elements of the entire asset to set baseline condition states; and,
- Develop component and overall asset ratings as part of the condition assessment.

The Baseline Inventory record includes two primary items:

1. **Drawings and photographs** showing the current asset layout. In particular, the documented asset layout should provide a clear delineation of asset boundaries, a labeling system for individual elements (i.e., assigning column lines and beam numbering), and representative asset-type photographs (see Chapter 7 for reporting). The baseline drawings reflect a schematic "cumulative as-built" of the asset, incorporating any modifications, extensions, or demolition which may have occurred since original construction. For existing assets, this may require an extensive review of records and field verification of items.
2. **Documented quantities of elements**. Using the established labeling system, the documented quantities of elements should provide a means for future routine inspections to be conducted rapidly (i.e., all future inspection teams expect a certain number of steel piles or a specified quantity of bulkhead).

With the asset layout defined and an established labeling system, the remaining portion of a Baseline Inspection is to document any existing condition states using an element-based approach (discussed in Chapter 3) and develop component and overall asset ratings as part of the condition assessment (discussed in Chapter 6). This portion is essentially the same scope as a Routine Inspection. It is important that the Baseline Inspection be comprehensive enough to provide a complete asset file for database purposes and to provide the basis for future inspections. A thorough and well-documented Baseline Inspection will facilitate

time-efficient future routine inspections since asset inventory information and previous element-based inspection results will already be available as a starting point.

Ideally, a Baseline Inspection is performed before or soon after construction is completed for a new asset. Existing assets with no or limited inspection documentation will require a Baseline Inspection to fully document pre-existing conditions. Baseline Inspections should also be performed after modifications or significant repairs are performed to the asset.

Above water, the scope of a Baseline Inspection is a comprehensive visual inspection of all readily-accessible elements of the entire asset. Underwater, a Level I diving inspection as defined in ASCE 101 is required. The scope of the underwater inspection is limited to certain areas of the substructure. On the channel-facing substructure elements (e.g., "front" row of piles") and bulkhead wall, the inspection covers the full underwater height, from mudline to mean higher high tide (MHHW). On other elements of the structure (e.g. "interior" piles and pile caps), only the tidal zone is in scope. On certain assets, access to areas may be restricted by structure configuration, asset usage, or other concerns. In these areas, sonar imaging may be used to provide an inventory record of pile locations, slope depth and profile, and bulkhead location.

After the Baseline Inspection is completed, recommended follow-up actions should be generated as warranted. While it is important to comprehensively inspect the entire asset in a Baseline Inspection, if an element or component is not accessible due to temporary obstructions, a typical, recommended follow-up action is to flag the element for specific inspection on the next Routine Inspection. If the surrounding conditions of an obscured element indicate the element may have distress such that it affects the functionality and structural capacity of the asset, the temporary obstructions may be requested to be removed as an immediate follow-up action.

Finally, the Baseline Inspection provides recommendations for the timing and frequency of Routine Inspections, discussed in more detail in the following section.

2.3. Routine Inspection

The Routine Inspection includes both above water and underwater inspections and is the most commonly-performed inspection. Conducted at pre-defined intervals, the purpose of the Routine Inspection is to:

- Inspect readily-accessible elements of the entire asset. The scope of elements to be included is the same as in the Baseline Inspection.
- Update the inventory record with drawings/sketches/photographs documenting any changes in the asset. Note that significant changes due to modification or repair should be previously identified in the asset file as part of either a previous Baseline Inspection or Routine Inspection inventory record or repair/rehabilitation record.
- Update the inspection forms with changed condition states (i.e., identify new conditions, verify old conditions remain unchanged, have been repaired, or have increased in severity or extent). This information should be detailed enough to properly scope special inspections or recommended follow-up actions, and to assist in assigning component and overall asset ratings as part of the condition assessment.
- Update component and overall asset ratings as part of the condition assessment.

In particular, changes in element condition states and component and overall asset ratings can be observed over time to provide trends useful for management decisions. For example, over time it could be shown from the element-level data that the quantity of defects on the reinforced concrete deck on Asset A has increased 5 percent per year over the last 15 years, or that Asset B has poor component ratings compared to Asset C and repairs should be prioritized accordingly. If Baseline Inspection records are available and accurate, routine inspections can be efficiently conducted. While the inspection time is still dependent upon existing conditions, rapid changes in conditions are not typical; therefore, routine inspections can be more clearly focused on ensuring the existing record is updated with any changed conditions.

The inspection interval for Routine Inspections is defined by the PHA, and may vary from asset to asset. The default inspection interval under the FICAP is a maximum of 3 years for above water and 6 years for underwater inspections. The outcome of an inspection and condition assessment may recommend more frequent inspections for a particular asset based on observations of advanced or severe deterioration. More frequent inspections may also be recommended for assets where the type of use (e.g., heavy use, public access, high priority use) warrants more frequent assessment. Less frequent inspections may be recommended for newly constructed assets or for assets where the condition or use warrants an increased inspection interval. Selection of inspection frequency for any structure will be made by the PHA after review of the recommendations of the inspection and condition assessment team.

The above and below water inspection requirements are similar to that described for the Baseline Inspection. Above water, the scope of a Routine Inspection is a comprehensive visual inspection of all readily-accessible elements for the entire asset. Underwater, a Level I diving inspection, as defined in ASCE 101 is required with the same scope for elements as defined in the Baseline Inspection (see Section 2.2). The Baseline Inspection may have recommended that sonar imaging be used for Routine Inspections in lieu of the Level I inspections on parts of the structure, such as for areas with closely-spaced piles that preclude reasonable diving access.

After each Routine Inspection is completed, recommended follow-up actions may include special inspections with prescribed levels of effort (optional), or increased inspection frequency or levels of effort for future routine inspections.

2.4. Special Inspections

The primary inspection types under the FICAP are the Baseline and Routine Inspections. In some situations, Special Inspections may be required outside of the regular inspection program. Three types of Special Inspections are defined in the Manual: Post Event, In-Depth, and Due Diligence, as outlined below. These inspection types are would be implemented as and when needed at the discretion of the PHA.

2.4.1. Post-Event Inspection

A Post-Event Inspection is an immediate and rapid inspection that is performed in response to natural disasters (e.g., floods, hurricanes) or other events (e.g., vessel impact, fire) that may have caused damage. The purpose of this inspection is to:

- Immediately survey the affected asset as soon as possible after the event takes place.
- Inspect readily-accessible elements in the affected area.
- Assess the event's impact on overall structural integrity and functionality of the asset.
- Delineate damaged portions of the asset and the severity of damage.

- Provide any recommended actions, such as shoring, repairs, or further evaluation.
- Provide post-event component and overall asset ratings as part of the post-event condition assessment.

The Post-Event Inspection is not a comprehensive inspection, but rather is targeted to the areas that may be damaged. Findings of the inspection also have a different objective than Routine or Baseline Inspections. Accordingly, the component rating criteria for this inspection type (see Section 6.3) are different from those used for Baseline and Routine Inspections. The level of effort should be sufficient to make an overall assessment of the component condition related to the event in question. Typically, a Post-Event Inspection is a "bird's eye" view of elements to determine if the event caused significant damage. Previous inspection records should be reviewed and compared with observed damage to gauge whether or not the damage is new or a pre-existing condition.

The PHA has separate Post-Event Inspection procedures for other aspects of Port Houston's facilities. Inspection work performed for the maritime assets under this manual procedures should be coordinated with those efforts. Post-Event Inspections will be performed at the discretion of the PHA Director of Project and Construction Management.

2.4.2. In-Depth Inspection

In-Depth Inspections are typically a result of a recommended action from a previous inspection or with the purpose to provide additional detailed information for change of use, rehabilitation or repair design, etc. The objective and scope for each In-Depth Inspection should be specifically defined and agreed upon between the Owner and Inspection Team. Even though In-Depth Inspections do not follow the predefined format of a Baseline or Routine Inspection, it is still expected that the nomenclature and evaluation of elements be consistent with the element-based approach defined in this Manual. An In-Depth Inspection is typically performed to collect detailed condition assessment information in order to:

- Understand the cause and extent of deterioration (destructively or nondestructively);
- Predict the remaining service life of a component or asset, if required;
- Evaluate the effect a particular condition has on structural capacity or load rating; and/or,
- Characterize conditions in sufficient detail for repair or modification construction documents to be prepared.

The In-Depth Inspection may involve material sampling and testing, nondestructive evaluation, structural analysis, or load rating as required. Inspection is not necessarily limited to readily-accessible elements; if inaccessible elements are included in scope, the project proposal should describe the means of inspecting these areas. For underwater inspections, the In-Depth inspection will likely require all three inspection levels defined in ASCE 101 and may also include sonar imaging as necessary.

2.4.3. Due Diligence Inspection

A Due Diligence Inspection is a limited inspection to provide relevant information for legal reasons, such as changes of ownership, tenants, leases, insurance policies, etc. Similar to the In-Depth Inspection, the objective and scope should be specifically defined and agreed by the purchaser (which may be the facility Owner or another contractual party) and the Inspection Team. A Due Diligence Inspection is typically performed for one or more of the following reasons:

- Provide an engineering opinion of probable cost of future maintenance or repair for financial investments or insurance purposes.
- Inspect a portion of readily-accessible elements on the asset.
- Estimate order-of-magnitude replacement or modification costs.
- Provide general condition assessment of the asset as defined and agreed by the purchaser and the Inspection Team.
- Assess change in conditions or damage to an element due to usage of tenants.
- Evaluate effectiveness of maintenance performed by tenants, if maintenance of facility is included in a lease.

2.5. Engineering Analysis

The scope of the inspection and condition assessment types defined in the preceding sections is not intended to include detailed engineering analysis. In this context, the term "engineering analysis" is assumed to include:

- Structural evaluation to quantify structural capacity, including accounting for the effect of the observed defects or damage.
- Load rating of an asset.
- Service life analysis or prediction for an asset.
- Quantitative evaluation of the need for repairs or strengthening.

An inspection may identify significant damage, defects, atypical conditions, or potential structural or functional concerns that may require an engineering analysis to fully assess. In these situations, the inspection and condition assessment team should include this finding in their recommended follow-up actions (see Section 7.5). The engineering analysis is considered outside the scope of the FICAP, and would be pursued at the discretion of the PHA.

2.6. Relationship Between Inspection Types

The primary objectives of the FICAP are achieved by conducting a Baseline Inspection for each maritime asset followed by regularly scheduled Routine Inspections. A Baseline Inspection establishes the initial asset inventory information and component and overall asset ratings, and is applied to every new asset and to existing assets where no previous inspection record exists. It may also be implemented after a major modification to an asset. A Routine Inspection defines the asset condition, component and overall asset ratings, and element condition states at a point in time and allows tracking of conditions over time. The outcomes of a Baseline or Routine Inspection may include:

- No further action is required; asset is scheduled for its next Routine Inspection.
- More information is needed and/or repairs are required; conditions observed indicate that further investigation or repairs are required, prompting an In-Depth Inspection.
- Immediate action is required; observed conditions may compromise structural integrity or facility operations or may lead to property or environmental damage and require immediate attention.

The In-Depth Inspection is not considered part of the regular FICAP program of Baseline and Routine Inspections, and is implemented at the discretion of the PHA as and when warranted by other inspections or situations. The outcomes of the In-Depth Inspection may include:

- No action required (return to scheduled Routine Inspections).
- More information is required (further in-depth inspection or an Engineering Analysis) depending on the conditions observed.
- Repairs or strengthening are required.
- Repurposing, rebuilding or retiring of the asset is required.
- Immediate action is required; observed conditions may compromise structural integrity or facility operations or may lead to property or environmental damage and require immediate attention.

The relationships between Baseline, Routine, and In-Depth Inspections are illustrated in Figure 2.1. The Engineering Analysis is also included in this figure, since it may be prompted as an outcome (Follow-Up Action) to an In-Depth Inspection. Further discussion of recommended follow-up actions (inspection outcomes) is provided in Chapter 7.

Due Diligence and Post-Event Inspections do not fit within the regular relationship of Baseline and Routine Inspections, but rather are prompted by specific needs or occurrences. These inspection types may be applied to maritime assets regardless of whether a Baseline Inspection has been conducted. The outcome of a Due Diligence or Post-Event inspection may include:

- No further action is required; asset is scheduled for its next Routine Inspection (or Baseline Inspection if not already completed).
- More information is needed or repairs are required; an In-Depth Inspection is required, possibly followed by Engineering Analysis, repairs or strengthening, repurposing, rebuilding or retiring of the asset.
- Immediate action is required to address conditions that may compromise structural integrity or facility operations, or may lead to property or environmental damage.

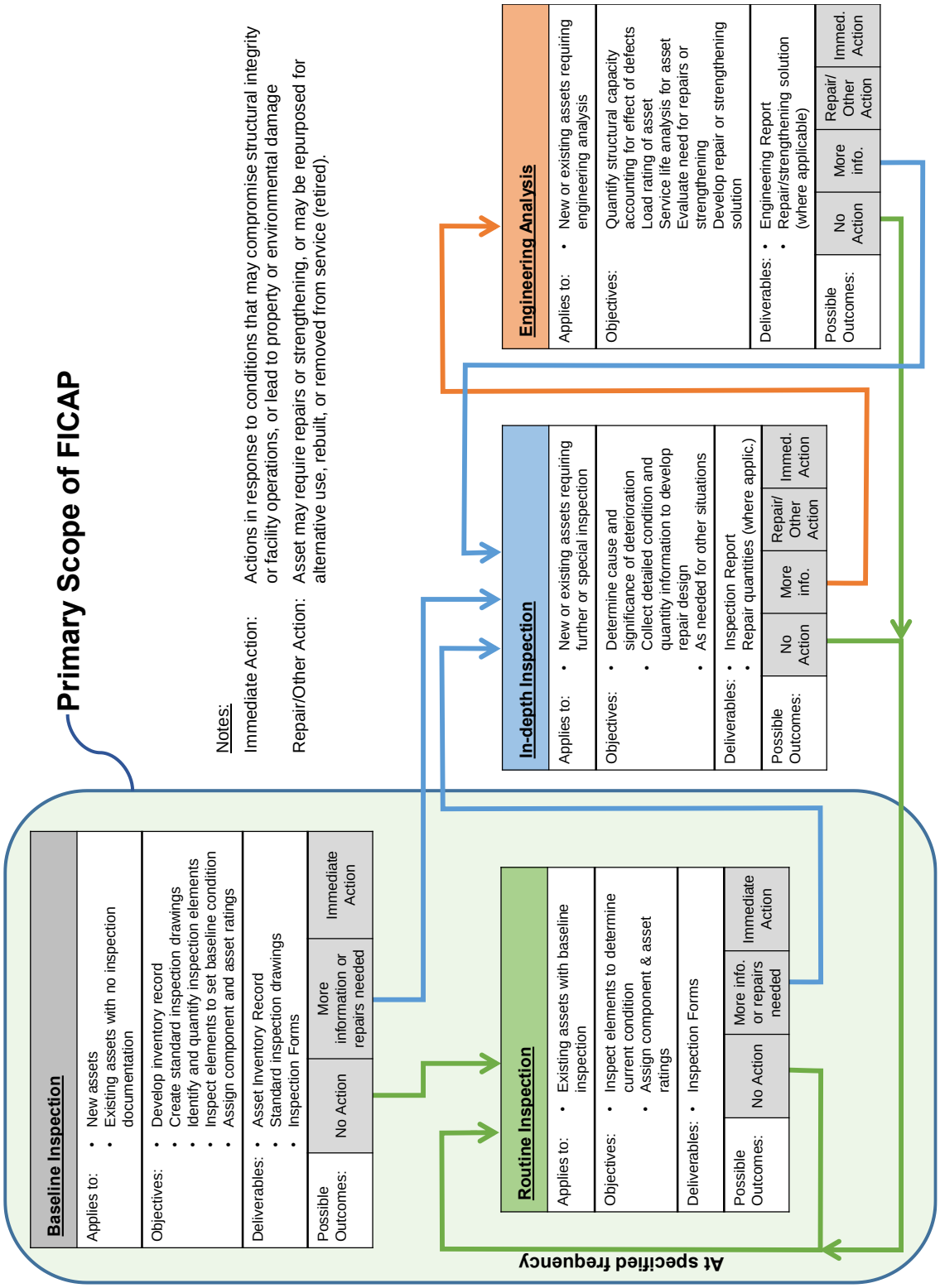


Figure 2.1. Relationship between Baseline, Routine and In-Depth Inspections

CHAPTER 3: ELEMENTS AND ELEMENT CONDITIONS

3.1. General

Components within an asset consist of multiple individual elements which may be structural (e.g., load-carrying elements such as a beam, slab, or pile) or non-structural (e.g., wearing surface, railing or fender facing). As discussed in Chapter 1, conducting the inspection on an elemental basis provides a systematic, objective, and comprehensive means of collecting inspection data. The following sections describe the elements that form a component, as well as how the condition of these individual elements are described during an inspection using defined condition states.

3.2. Element Type Descriptions

A broad range of structural and non-structural element types may be encountered in maritime assets. Element types are primarily defined by their structural or functional purpose and material type. Appendix C provides a list of element types arranged by the component with which it is associated. Terminology used in the element descriptions is defined in the Glossary (Appendix B). This list of element types contains the following information to describe each individual element:

- *Associated component.* This provides the component of which the individual element is a part.
- *Element code*. This code is used to indicate the element type and material for ease of documentation. The first two letters of the code are descriptive of the element type and the last two or three letters indicate the material type, as defined in Table 3.1.
- *Element descriptor.* A unique name is given for the individual element. Where applicable, the element name includes the material type, as defined in Table 3.1.
- *Element identification.* The element is described in narrative for identification and categorization by the field inspection personnel. Multiple element types may share the same description but differ by material type.
- *Measured units.* This indicates the measurement basis by which an element's condition state is quantified (e.g., area units, linear units, or per element occurrence).

While the element list in Appendix C is comprehensive, the list is not exclusive and other elements may be present in some maritime assets within the PHA inventory. The element types for a particular asset should be defined during the scope of a Baseline Inspection and should be referred to for all subsequent routine or other inspections. Categorization of undefined element types should be discussed with the PHA Project Contact to ensure that naming is consistent with the PHA asset management system.

Table 3.2 provides an example of element descriptions for a deck component.

Table 3.1. Basic Material Types for Structural Elements

Material		Abbreviation	Description
Concrete	Reinforced Concrete	RC	Conventional, reinforced, cast-in-place concrete
	Precast Concrete	PCC	Conventionally reinforced concrete that is cast off-site and then installed on the structure.
	Prestressed Concrete	PSC	Reinforced concrete with bonded or unbonded prestressing tendons. Elements may be precast or cast-in-place, and pre- or post-tensioned.
	Unreinforced (Plain) Concrete	UC	Concrete without reinforcement.
	Asphalt	AC	Aasphalt paving or patching material, typically used as wearing surfaces.
Metals	Steel	CS	Carbon steel materials. Typically coated or painted for corrosion protection.
	Stainless Steel	SS	Stainless steel materials. Stainless steels have a minimum of 10.5 percent chromium.
	Galvanized Steel	GS	Carbon steel that has been hot-dip galvanized with zinc.
	Metals (all other)	MT	Metals that do not fall into any of the other categorized. Includes aluminum, cast iron, ductile iron, etc.
Other	Timber	TIM	Rough, sawn, or engineered wood
	Rubber	RB	Rubber or elastomeric materials.
	Other materials	OTH	All other materials that do not fit in any of the predefined categories.

Table 3.2. Example of Select Element Descriptions

Element Code(s)	Element Descriptor	Element Identification	Units[1]
Deck Elements (DK)			
DT-RC DT-PCC DT-CS DT-TIM DT-OTH	RC Deck Topside PCC Deck Topside CS Deck, Open Grid TIM Deck Topside OTH Deck Topside	A horizontal, planar structural element that carries and distributes loads to superstructure or substructure elements. Observations specific to topside of element.	SF
DU-RC DU-PCC DU-TIM DU-OT	RC Deck Underside PCC Deck Underside TIM Deck Underside OTH Deck Underside	A horizontal, planar structural element that carries and distributes loads to superstructure or substructure elements. Observations specific to underside *or* full-depth of element.	SF
BO-RC BO-UC	RC Bonded Overlay UC Bonded Overlay	Concrete material cast on top of and bonded to a deck surface.	SF
TF-PCC TF-PSC	PCC Top Flange PSC Top Flange	Top flanges of girders or beams where live loads are applied directly on the structural element.	SF

[1]SF = square foot, LF = linear foot, EA = each
See Appendix C for complete list of element descriptions.

[1] SF = square foot, LF = linear foot, EA = each

3.3. Element Conditions and Condition States

Element conditions include potential damage, deterioration, or defects that may exist in an individual element. Conditions may be material-specific (e.g., corrosion in metals or honeycombing in concrete) or may be experienced by any element in general (e.g., settlement or distortion).

During a Baseline, Routine or Due-Diligence Inspection, relevant conditions should be documented for each individual element using four standard, predefined condition states specific to the various conditions observed. The standard condition states are comprised of good, fair, poor and severe general descriptions.

An example of selected element condition states that occur in reinforced concrete is shown in Table 3.3. A complete list of typical conditions and their defined condition states is provided in Appendix D. Appendix E provides the same lists, but arranged by material type for ease of use during an inspection (i.e., steel/metals, reinforced concrete, prestressed concrete, timber, composites/rubbers, etc.). Within this manual, the approach to the condition state definitions has been adapted in part from AASHTO (2013).

In order to provide a complete characterization of the element condition, three features of the condition should be established:

- Type of damage or deterioration (e.g., structural steel or reinforcement corrosion, concrete spalling, wood decay, impact damage, or wear).
- Severity of damage or deterioration (e.g., type and size of defects, severity of section loss).
- Scope or extent of damage or deterioration. This is quantified by the length, area, or number of elements having the condition state in question.

The process of providing this characterization is presented in the following section.

3.3.1. Documenting Element Condition States

The condition states provide a means for the Inspection Team to characterize and quantify any observable conditions exhibited by an individual element. As each element is inspected, the observed condition is categorized into one of the predefined condition states. An element may experience multiple conditions, even in the same location (e.g., exposed reinforcement may exist at the same location as spalled concrete). The extent of the condition is defined by recording the quantity of the condition state using the specified measured units defined for the element (see Table 3.2 and Appendix C). Inspection records for data entry are discussed in Chapter 8.

Table 3.4 provides an example of collected condition state data during a Routine Inspection. In this example, the element condition states for the top surface of two deck elements of type DT-RC (reinforced concrete deck) are shown. The Element ID is based on the naming scheme used to uniquely identify each element and is shown on the asset's baseline drawings, as described in Section 8.3. Each deck element has 400 square feet of total quantity in this example.

For the first deck element (labeled DT 5-1), 20 square feet was categorized as CS4 because 20 square feet of a CS4 spall (DLSP) was observed. Within this spalled area, 15 square feet of CS2 exposed reinforcement (EXRB) was also observed. In another location on the deck element, 30 square feet of delaminated area (also DLSP) categorized as CS3 was identified. These observations for DT 5-1 are recorded in Table 3.4 as follows:

- 30 SF of DLSP in CS3.
- 20 SF of DLSP in CS4.
- 0 [15] SF of EXRB in CS2; since this area of EXRB is coincident with the 20 SF of DLSP (CS4), it is listed as *"0"* for summing purposes so that the total deck area with distress is correctly recorded as 50 SF. Square brackets are used to denote that the area of CS2 EXRB was 15 SF, but that it was concurrent with a higher-level (more severe) condition state.
- 350 SF of CS1; this is the total area of DT 5-1 without distress.

For the second deck element (labeled DT 5-2), 20 square feet could not be inspected due to the presence of immovable material stored on the deck at the time of the inspection. Of the observable area, 75 square feet was categorized as CS3 cracking (CRKC), and 145 square feet was categorized as CS2 cracking. Note that within the 145 square feet of CS2 cracked area, 20 square feet of CS2 delaminated area was also identified. In this situation, the concurrent distress areas are both CS2, so the Inspection Team must use judgement to determine which of the two simultaneous conditions (CS2 cracked area or CS2 delaminated area) is more severe for the element. In this case, the DLSP is deemed the higher-level or more severe condition state. The inspection observations for DT 5-2 are recorded in Table 3.4 as follows:

- 20 SF of inaccessible area; could not be observed at the time of inspection.
- 125 [20] SF of CKRC in CS2; the bracket notation indicates that there is 145 SF of CKRC (CS2), but that 20 SF is concurrent with another condition (DLSP in this case).
- 75 SF of CKRC in CS3.
- 20 SF of DLSP in CS2.
- 160 SF of CS1; this is the total inspectable area of DT 5-2 without distress.

To report quantities for deck elements as a group, the quantities are summed based on the condition state subtotals, irrespective of which type of condition was the cause of a condition state. For this hypothetical deck, this results in a total of 800 square feet of possible deck surface, of which 510 square feet is CS1, 145 square feet is CS2, 105 square feet is CS3, and 20 square feet is CS4 (total of 780 square feet with an assigned condition state). The use of the square brackets to indicate areas of concurrent distress types is necessary to correctly arrive at these condition state totals for the deck element group. Portions of the element which were inaccessible for the inspection (20 square feet) are recorded separately and are not assigned a condition state.

3.3.2. Protective Layers – Coatings and Jackets

Some elements may be protected from deterioration by sacrificial, replaceable materials, such as coatings, jackets, or paints. These protective layers are inspected and their condition state is identified in association with the underlying element to which they are applied. It is probable that deterioration or degradation of the protective layer will "lead" that of the underlying material. For example, it is expected that a steel coating would degrade and fail (CS4 condition) prior to detrimental section loss of the member below. For this reason, condition states solely associated with the protective layer (e.g. CHLK, GALV, PEEL, etc.) should not be considered the controlling state and should always be marked with brackets.

Table 3.3. Example of Selected Condition States for Reinforced Concrete*

Code	Condition	Definition	Condition States			
			CS1 (Good)	CS2 (Fair)	CS3 (Poor)	CS4 (Severe)
ABWC	Abrasion/ wear	Abrasion or wear in concrete elements or wearing surfaces (including cementitious and bituminous).	No abrasion or wear.	Coarse aggregate is exposed but remains secure in concrete matrix.	Coarse aggregate has been exposed and is loosened from concrete matrix due to wear.	N/A
CRKC	Cracking [See Appendix D Table Note 1]	Cracking in concrete elements and wearing surfaces (including cementitious and bituminous materials)	Insignificant cracks i.e., or moderate-width cracks that have been sealed.	Unsealed moderate-width cracks i.e., or unsealed moderate map cracking.	Wide cracks i.e., or heavy map cracking. For structural elements, this excludes cracks associated with reduction of structural capacity (e.g., bond splitting cracks, shear, bending, or torsional stress cracks)	Wide cracks associated with reduction of structural capacity or functionality (e.g., i.e., loss of bond, shear, bending, or torsional stress cracks).
DLSP	Delamination/ spall (partial-depth)	Spalls or delamination in concrete elements or wearing surfaces. Distress does not extend through full thickness of element.	No delaminated or spalled areas.	Delaminated. Spall is less than 1 inch in depth or less than 6 inches in diameter. Patched area is sound. Partial depth pothole in wearing surface.	Spall greater than 1 inch in depth or greater than 6 inches in diameter.	Significant spalls or distress to patched areas is significant enough to affect element's immediate functionality or capacity
EXPR	Exposed reinforcement	Exposed conventional reinforcement in concrete elements. Excludes prestressing strands.	No exposed reinforcement.	Exposed reinforcement without measurable section loss.	Exposed reinforcement with measurable section loss, but assessment has determined element's functionality or capacity is not compromised.	Exposed reinforcement with section loss that is significant enough to affect element's immediate functionality or capacity

* Note: Condition state definitions for some conditions have been adapted from AASHTO (2013).

Table 3.4. Example of Condition States for Deck Elements

Element Location ID	Element / Condition Code	Units	Total Quantity	In-accessible	Condition States (quantity [counted with other CS])			
					CS1	CS2	CS3	CS4
DT 5-1	DT-RC	SF	400	0	350	0	30	20
	– DLSP	*SF*	*50*				*30*	*20*
	– EXRB	*SF*	*15*			*0 [15]*		
DT 5-2	DT-RC	SF	400	20	160	145	75	0
	– CRKC	*SF*	*220*			*125 [20]*	*75*	
	– DLSP	*SF*	*20*			*20*		
Deck Subtotal	**DT-RC**	**SF**	**800**	**20**	**510**	**145**	**105**	**20**

CHAPTER 4: COMPONENT TYPES

4.1. General

A component is a group of elements that make up a particular structural or non-structural system. Examples of structural component types are the deck, superstructure and substructure; examples of non-structural component types are fender and mooring systems. The boundaries between component types are dictated by structural or functional purpose within the overall asset, but may also consider logical distinctions based on changes in structural system, framing, or construction material.

Components can be grouped according to their function or purpose, and based on the type of factors to be considered when determining ratings for the component. For the purposes of this manual, components are categorized in four groups as listed in Table 4.1. The components in each of the four groups are defined in the following section.

Table 4.1. Component Group Descriptions

Group	Description
Structural Component	A group of elements that comprises a structural system (e.g., deck, superstructure, substructure, bulkhead, joints).
Berthing Component	A group of elements that serves a functional purpose related to the berthing of vessels (e.g., mooring system or fender system).
Shoreline Components	A group of elements (or a single element) that primarily defines the channel shoreline within a property or terminal (e.g., unprotected shoreline, rip-rap protected shoreline). Shoreline components are not associated with a specific asset (e.g., wharf).
Ancillary Components	A group of elements that serves a purpose other than categorized as above (e.g., utility system supports, paint and markings, personnel access systems). The location of the ancillary element anchor or attachment to a birthing or structural element is described and characterized by condition states (e.g., damage to anchored or attachment area), but FICAP does not address the condition state of the ancillary elements themselves.

4.2. Component Definitions

Commonly-encountered component types for maritime assets are defined below within the groups described in the preceding section. This component list is not exclusive; other component types may be present in some maritime assets within the PHA inventory. The component types for a particular asset should be defined during the scope of a Baseline Inspection and should be referred to for all subsequent routine or other inspections. Categorization of undefined component types should be discussed with the PHA Project Contact to ensure that naming is consistent with the PHA asset management system.

Structural Components

Deck (DK) — Component that provides a flat and safe working surface for the users of the wharf. Live loads (e.g., cranes, vehicles, stored materials) are applied directly on the deck. Serves the structural purpose of transferring the live loads and dead loads (deck self-weight and any superimposed dead loads such as a

	wearing surface) to the superstructure or in some cases directly to the substructure. Usually composed of reinforced concrete, but may also be steel, timber, and other materials. Deck components may include elements such as protection systems or wearing surfaces. Joint are considered a separate type of component for inspection and inventory purposes.
Slabs and Wearing Surfaces (SL and WS)	Concrete slab or pavement on grade (soil, fill, etc.). May include approach slabs (for bridges) or slabs on top of supported wharf fill. Pavement beyond the land-most bulkhead is excluded from this inspection program. Wearing surfaces include asphalt and unbonded concrete toppings.
Superstructure (SP)	Component that supports the deck and serves the structural purpose of transmitting load from the deck into the substructure. Primary elements include girders, floor beams, and stringers. Additional elements in this group include cables, gusset plates, and hanger assemblies. May be composed of reinforced concrete, steel, timber, or other materials.
Substructure (SB)	Component that supports the superstructure or deck directly and serves the structural purpose of transmitting load effects from the superstructure or deck to the foundation soil or rock. Made up of elements including relieving platforms, columns, drilled shafts, piles, pile caps, piers, shear walls, or retaining walls. May include steel, concrete, timber, and other materials.
Bearings (BR)	Component that provides an interface between the superstructure and the substructure for certain types of assets. Serves the structural purpose of transmitting load effects from the superstructure to the substructure. May be designed to be fixed, or capable of rotation, lateral movement, or vertical movement. Common types are referred to as moveable bearings, elastomeric bearings, pot bearings, disk bearings, fixed bearings, and enclosed or concealed bearings.
Joints (JN)	Component that accommodates the relative movements (expansion, contraction rotation) between the deck and superstructure, or between different regions (spans) of the deck or superstructure. Joints may be sealed or unsealed. Common types are referred to as strip seal expansion joints, pourable joint seals, compression joint seals, assembly joints with seal (modular), open expansion joints, and assembly joints without seal.
Bulkhead (BH)	A component or asset used in maritime construction to retain earth fill and separate land from the water. Similar to a retaining wall, and commonly composed of driven steel sheet piles or a barrier of interconnected wooden, steel, or reinforced concrete vertical members and backfilled on one side. The top may be anchored to a deadman, cantilevered, or braced on another component. Bulkheads are considered a component when part of an overall maritime asset (e.g., wharf), or as a standalone asset if not.
Berthing Components	
Fender System (FS)	Component consisting of energy-absorbing devices used on the face of a maritime asset to provide protection for both the asset and the vessel from the impact during berthing and continuous loading while the vessel is moored

	due to wind, current, and waves. Common types include fender pile systems, directly-mounted fender units, and floating fender systems.
Mooring System (MR)	Component consisting of elements used to attach vessel mooring lines to a fixed point on the maritime asset. Mooring system must resist constant and fluctuating mooring forces due to wind, currents, and wave action on the vessel. Mooring elements may be attached to a maritime asset, such as cleats and bollards on a wharf deck, or may be self-supporting, such as dolphins.
Shoreline Components	
Protected Shoreline (SH)	Components providing protection to shoreline within the boundaries of a terminal or property. Protection elements include riprap, block walls, gabion baskets, and revetments.
Unprotected Shoreline (SU)	Unprotected or undeveloped shoreline within the boundaries of a terminal or facility.
Ancillary Components	
Crane and Train Rails (CT)	Component consisting of track and rail elements attached to deck components of a maritime asset. Also includes crane tie downs and crane stops. Inspection and condition assessment of these elements addresses the general condition of the element and the connection to and support by the structural or non-structural components. Does not include mechanical operation such as track switches.
Guards (GU)	Component consisting of elements providing vehicle and pedestrian edge protection for the channel side of the wharf. Includes elements such as wharf logs, railings, or concrete barriers that are fixed (i.e., not routinely moved). Note that security fences, cameras, etc., are not considered within the scope of the FICAP.
Paint and Markings (PM)	Component consisting of paint and other markings for regulatory or information purposes (not for protection).
Personnel access systems (PA)	Component consisting of elements related to personnel access to areas of the maritime asset. Elements include catwalks, ladders, fall protection, and other personnel access systems. Inspection and condition assessment of these elements addresses the general condition of the element and the connection to and support by the structural or non-structural components.
Utility Systems (UT)	Component consisting of elements such as utility lines, risers, hangers, brackets, and accessories attached to other structural or non-structural components in the maritime asset. Also includes cable horns and trenches. Inspection and condition assessment of these types of elements addresses the general condition of the element and the connection to and support by the structural or non-structural components. Inspection does **not** consider an in-depth assessment of the utility element condition, such as remaining thickness and interior condition of piping, valves, and other elements.

CHAPTER 5: MARITIME ASSET TYPES

For the purpose of this Manual, a maritime asset is a reporting unit which has a defined boundary and serves a functional purpose. Four primary asset types are considered: wharves, boat docks, bulkheads, and shore protection. A list of assets applicable to this Manual is included in Appendix A. The four primary asset types are described in the following sections.

5.1. Wharves

Wharves are structures partially supported on land, and oriented parallel to the shore where ships can be moored at the offshore face. For this Manual, wharves are assets intended for the loading or unloading of cargo or personnel on large vessels (general cargo, break bulk, liquid, containers, cruise ships, etc.). Barge docks are also included as a subset of wharves. A single wharf structure consists of one or more types of structural systems, which are outlined in four major categories below.

1. **Open Platform with Open Structure.** This type of wharves have an underwater slope extending from the landside to the channel bottom. The wharf structure is supported over water by piles or drilled shafts, and water may freely move underneath. The wharf deck is supported either directly on the substructure elements or on a series of superstructure elements. Soil on the landside of the structure is retained with either a curtain wall or a sheet pile bulkhead. The underwater slope may be protected or unprotected from erosion.
2. **Open Platform with Solid Structure.** This type of wharf is similar to the previous one in that water is free to move underneath the structure. The difference is that the deck is supported on fill, which is in turn supported on a structural platform slab. This platform slab is usually constructed above the water line, but on some older wharves it may be below the water line due to settlement or subsidence.
3. **Solid Bulkhead.** This type of wharf has a vertical bulkhead from the face of the structure down to the channel bottom. The wharf structure behind the bulkhead consists of fill and may be topped by a concrete slab-on-grade. The bulkhead may be constructed by a continuous row of sheet piles (typically tied back to a deadman) or from a series of cells that rely on hoop stresses to resist lateral soil pressures.
4. **Solid Bulkhead with Relieving Platform.** This type of wharf is similar to the Solid Bulkhead but also has a buried supporting structure. This buried structure consists of a number of bearing piles connected by a relieving platform. Above the relieving platform is fill and a concrete slab-on-grade. This type of structure generally reduces earth pressures on the bulkhead by allowing surcharge loads to be carried by the bearing piles.

5.2. Boat Docks

Boat docks are similar to wharves but distinct in that they are not intended for the large-scale offloading of cargo or people. Also, unlike wharves, docks are self-supporting structures. The boats they serve are generally smaller than those berthed by wharves and so are subject to smaller berthing and mooring forces. They are often constructed from timber or steel framing. Three general categories of construction apply to boat docks.

1. **Open Platform with Open Structure.** See description for wharves above.
2. **Solid Bulkhead.** See description for wharf type above.

3. **Floating Platform.** This type consists of a buoyant platform with a deck, anchored to either shore or the bottom of the channel. Buoyancy is be achieved by either hollow or foam-filled elements. Floating platforms are free to move in elevation up and down with the change in tides.

5.3. Bulkheads

Bulkheads serve the purpose of separating the shoreline from the water with a vertical step in elevation. Some underwater slope may or may not be present between the bottom of the bulkhead and the main channel. Bulkheads are cantilevered, restrained by anchors at the top, or made of cellular structures. If a bulkhead is associated with a wharf or boat dock, it is considered a component; where bulkheads are unassociated with a wharf or boat dock, they are considered an asset.

5.4. Shoreline

Shoreline assets are designated as unprotected shoreline or protected shoreline. The channel shoreline, if unimproved or unprotected, would form a natural slope to the bottom. Tides and waves can erode and move this shoreline where it is unprotected. Protected shoreline consists of supplemental material placed on the soil slope to protect it from erosion. This material can be natural stone (rip rap), concrete blocks, or other similar materials, and may or may not be stabilized with geotextile material.

CHAPTER 6: ASSESSMENT AND RATING APPROACH

6.1. General

As described in Chapter 1, this Manual employs an element-based inspection and condition assessment approach wherein inspections are performed at the element level and ratings are assigned at the component and asset level. Based on the individual component ratings and the element-level inspection data, an overall asset rating is produced describing the overall asset condition.

Baseline, Routine and Due Diligence Inspections involve a detailed inspection to categorize the condition states of individual structural and non-structural elements. Using well-defined element condition states (as presented in Chapter 3) provides a justifiable, consistent, and comprehensive indication of element condition. The detailed element condition information facilitates an engineering evaluation of the structural and functional implications of the element condition to provide a sound basis for rating each component of the maritime asset. The component ratings in turn allow conclusions to be made regarding the overall asset condition. The component ratings defined in Section 6.2 are applicable for Baseline, Routine and Due Diligence Inspections and may be used for In-Depth inspections where appropriate.

As described in Chapter 2, the objectives of a Post-Event Inspection are typically different from those of other inspection types. Given the circumstances of an extreme event, the Post-Event Inspection is intended to provide a more rapid and overall condition assessment of a specific damage location in comparison to the more detailed element-based inspections. For this reason, the component and asset ratings approach for Post-Event Inspections is defined differently than other inspections and is detailed in Section 6.3.

The following sections define the condition rating process for components and overall assets for Baseline, Routine and Due Diligence Inspections.

6.2. Component Rating

This section defines the component condition assessment process for Baseline, Routine, and Due Diligence Inspections. It may also be applied to In-Depth Inspections, depending on their specific objectives and scope.

Upon completion of the element-based inspection, the condition assessment process involves determining ratings for each component. The component ratings are assigned relative to the assumed as-built condition of the component and are intended to reflect physical conditions including the effects of deterioration or damage. They are not intended to rate the component or asset in regards to its current or future use or loading, which may be different from that at the time of original construction.

The element-based inspection and condition assessment approach defined in this Manual provides a quantitative evaluation of element condition using the element condition states and quantities as described in Chapter 3. Although the element condition is quantitative, there is no direct (quantitative) relationship or formula to relate the element condition states to the component ratings, since the influence of the element conditions on the component condition depends on many complex factors. Instead of a formula-based approach, the component ratings are assigned by the engineer based on an interpretation of the influence of the observed element conditions on the component condition. Engineering judgement must be applied to determine the rating for a particular component. The factors to be considered include:

- Element condition state, defined in terms of:

- Type of damage, deterioration, or defects (e.g., corrosion, concrete spalling, wood decay, impact damage, or wear);
- Severity of damage, deterioration, or defects (e.g., type and size of defects, section loss);
- Scope or extent of damage, deterioration, or defects (e.g., local or general in terms of number of defects, area/length affected);

- Implication of observed damage, deterioration, or defects on the structural or functional performance of the affected elements; and,
- Overall implication of the element condition on the structural integrity, serviceability, and functionality of the component in question, including redundancy of elements in the component. For example, a grid of piles below a platform slab would be likely be able to sustain loss of a single pile without a significant impact to the overall capacity of the structure. In contrast, a bent with two piles supporting a T-dock bridge would be severely impacted by the loss of a single pile.

The component should generally be rated considering its overall condition, which may not necessarily reflect localized or element-level conditions. However, since both the severity and extent of the conditions should be considered, as well as the structural or functional implications of the compromised condition, localized severe conditions in one element may have a negative effect on the overall performance of the entire component, thereby resulting in a lowered rating for the component. The component rating is selected by interpreting condition states that apply to a broad range of elements and materials. Accordingly, the engineer making the condition assessment should be qualified and have appropriate knowledge and experience in terms of the structural system, component, material types, and associated deficiencies.

The component ratings in this Manual are assigned on a scale from 1 to 6, ranging from critical to good condition. Different component rating criteria are defined for the different component groups defined in Chapter 4 and are presented in the following sections by component group.

The component ratings should be accompanied by recommended follow-up actions, which are an important part of the inspection and condition assessment outcome. The follow-up actions provide guidance as to what actions may be required to address or further investigate the condition of a particular component or element. Any component with a rating of 3 (Poor) or less **must** be accompanied by a recommended follow-up action. Recommended follow-up actions are described in Chapter 7.

6.2.1. Ratings for Structural and Berthing Components

Component ratings for structural and berthing components are presented in Table 6.1. The ratings for structural components are primarily described in terms of the possible impact of the observed conditions on the structural capacity of the component. Berthing components serve both structural and functional purposes. Accordingly, the component rating descriptions include language to address the functional aspects of berthing components. In regards to structural performance, the following definitions are provided:

Structural Capacity:	The strength of the component or element as designed at the time of original construction or as modified by repair or strengthening.
Load Rating:	The adequacy of the component or element to carry specified loads, which may be higher or lower than that at the time of original construction.

The distinction between structural capacity and load rating is important, since the component rating should be assigned relative to its structural capacity; the load rating of a maritime asset should not influence the component ratings. For example, a component in an existing asset that has only negligible damage or deterioration should be rated as "good" since its structural capacity would be more or less equivalent to its original design strength. This rating of "good" should be applied even if the component is unable to carry the current load requirements of the asset. Note that load rating to determine the adequacy of a component to carry specified loads is not included within the scope of a Baseline, Routine, Due Diligence or Post-Event Inspection as defined in this Manual.

Table 6.1. Ratings for Structural and Berthing Components

Rating	Description
6 Good	Minor or no problems noted. Also applies to newly constructed or rehabilitated components.
5 Satisfactory	Minor defects, damage or deterioration - not extensive.
4 Fair	Extensive minor or limited moderate defects, damage or deterioration. Structural capacity of primary structural components and functional use of fender or mooring systems are not affected.
3 Poor	Moderate or extensive defects, damage or deterioration that affects structural capacity of primary structural components or functional use of fender or mooring system components.
2 Serious	Defects, damage or deterioration significantly reduces structural capacity of primary structural components or reduces functional use of fender or mooring systems.
1 Critical	Advanced defects, damage or deterioration with localized failure(s) of components imminent or observed. Immediate load or use restrictions, including closing of the asset should be considered.
Applicable Component Types: Deck, superstructure, substructure, bearings, bulkheads, mooring and fender systems.	

6.2.2. Ratings for Shoreline Components

The component ratings for protected shoreline and unprotected shoreline components are presented in Table 6.2. The shoreline components of a maritime asset may serve a structural purpose (e.g., fill retention) and a functional purpose (e.g., shoreline definition, erosion control). Accordingly, the component ratings for shoreline components include both structural and functional considerations. If some usage or configuration change in the ship channel has affected shoreline stability, it should be noted in the inventory report as a follow-up action.

Table 6.2: Ratings for Shoreline Components

Rating	Description
6 Good	Minor or no problems noted. Also applies to newly constructed or rehabilitated shoreline components.
5 Satisfactory	Minor defects, damage or deterioration - not extensive.
4 Fair	Protected shoreline: Extensive minor or limited moderate defects, damage or deterioration observed but does not affect shoreline protection. Unprotected shoreline: Extensive minor or limited moderate indications of shoreline beginning to slump. May be minor movement of shoreline.
3 Poor	Protected shoreline: Moderate or extensive deterioration or displacement that affects shoreline protection. Unprotected shoreline: Moderate or extensive indications of shoreline slumping or movement.
2 Serious	Protected shoreline: Deterioration, displacement, or breakage significantly affects the shoreline protection and local failures are possible. Unprotected shoreline: Shoreline is being eroded. Local slump or embankment failures are present. Use restrictions may be necessary for roadways, railways and working areas near shoreline.
1 Critical	Protected shoreline: Very advanced deterioration, displacement, or breakage with localized failure(s) of primary shoreline protection imminent or observed. Shoreline is being eroded and/or shoreline movement has occurred. Unprotected shoreline: Widespread erosion and/or slump or embankment failures have occurred. More widespread failures are possible or likely to occur. Immediate actions, such as emergency shoreline protection measures, use restrictions, or barricading of roadways, railways and working areas near the shoreline should be considered.
Applicable Component Types: Protected shoreline, unprotected shoreline.	

6.2.3. Ratings for Ancillary Components

The component ratings for ancillary components including utility systems, paint and markings, crane and train rails, joints, and personnel access systems are presented in Table 6.3. These components may carry some loads (e.g., utility supports), but do not serve a primary structural purpose. Correspondingly, they serve a primarily functional or regulatory purpose and the associated component ratings are largely functional-based.

Table 6.3: Functional Ratings for Ancillary Components

Rating	Description
6 Good	Minor or no problems noted. Also applies to newly constructed or rehabilitated protective components.
5 Satisfactory	Minor defects, damage or deterioration - not extensive.
4 Fair	Extensive minor or limited moderate defects, damage or deterioration. All primary elements and their attachment to the asset are sound and functional purpose/use of the component is not affected. Minor repairs or maintenance may be required.
3 Poor	Moderate or extensive defects, damage or deterioration that affects functional purpose/use of the component or compromises attachment of the component to the asset.
2 Serious	Defects, damage or deterioration significantly affects functional purpose/use of the component and/or local failures of the attachment to the asset are present.
1 Critical	Advanced damage or deterioration has resulted in frequent imminent or observed failure(s) of the attachment of the component to the asset. The component may no longer serve its functional purpose/use and/or conditions are present that may lead to property damage or environmental damage. Immediate repairs or other protective measures should be considered, and/or immediate use restrictions should be considered for components affected.
Applicable Component Types: Joints, utility system supports, paint and markings, crane and train rails, personnel access systems.	

6.3. Condition Rating for Post-Event Inspections

As described in Chapter 2, the purpose and scope of the Post-Event Inspection is notably different from that of the other inspection types. Specifically, the Post-Event Inspection is intended to provide an immediate, rapid overall assessment of a maritime asset after an extreme event such as a hurricane, flood, or vessel impact to determine whether the event resulted in significant damage that requires repairs, restricted use, or closing of the asset. Because of this immediate need, they may often be conducted by PHA staff or by an on-call engineering firm. The outcome of the post-event inspection should be a damage rating for the major components of the asset, and recommended follow-up actions with prioritization.

Given the unique nature of the Post-Event Inspection, the condition assessment protocol is different from that used for the other inspection types. Specific factors to be considered include:

- The inspection is typically limited to a visual assessment of the damaged above water portion of the asset. If the particular asset type or nature of the event suggests that the underwater portion of the asset may be at risk, the scope of the inspection should be expanded to include underwater areas.
- Due to the rapid need for deployment, qualifications of the inspector(s) conducting the Post-Event Inspection may be adjusted at the discretion of the PHA Director of Project and Construction Management.
- A detailed element-based inspection is not required. While individual elements may be inspected, the comprehensive documentation of element condition states is not within the scope of the Post-Event Inspection. However, specific element conditions arising from the event should be noted in the inspection report.

- Each major component of the asset should be assigned a damage rating based only on event-related conditions. Pre-existing damage, deterioration, or defects resulting from other mechanisms or occurrence should not influence the post-event ratings. However, any conditions requiring immediate attention, such as those that may compromise structural integrity or facility operations, or lead to property or environmental damage, should still be noted in the inspection report and addressed in the follow-up actions, regardless of cause.
- The post-event damage ratings used in this Manual are presented in Table 6.4. These ratings are based on those proposed by ASCE 130 (2015). The rating scheme has four levels, ranging from A (no event-induced damage - no further action required) to D (major damage - urgent remedial measures required). The alternate scheme, including the use of letters instead of numbers to indicate the rating levels, is important to distinguish the inspection objectives and outcomes from those in the other inspection types.
- The ratings in Table 6.4 are intended to be applied to the major components of the asset, and should reflect the overall condition of the component resulting from the event. Both the severity and the extent of the damage should be considered, along with its structural and functional implications, when assigning the damage ratings.
- Assignment of the damage ratings should be accompanied by specification of follow-up actions (see Chapter 7: Recommended Follow-up Action Guidelines). These may include emergency actions, repairs, further inspection, engineering analysis, or no action required.

Table 6.4: Damage Ratings for Post-Event Inspections

Rating	Description
A	No significant event-induced damage observed; no further action is required.
B	Minor to moderate event-induced damage observed, but all primary structural elements are sound. Repairs may be required, but the priority of repairs is low.
C	Moderate to major event-induced damage observed that may have significantly affected the structural capacity of primary elements and components. Repairs are necessary on a priority basis. Loading or use restrictions may be necessary.
D	Major event-induced damage has resulted in localized or widespread failure of primary structural components. Additional failures are possible or likely to occur. Urgent remedial attention is necessary. Immediate load or use restrictions, including closing of the asset should be considered.
Applicable Component Types: All	

6.4. Overall Asset Condition Assessment

This section discusses the overall asset condition assessment for Baseline, Routine, and Due Diligence Inspections, which includes an overall asset rating and a qualitative description of the asset condition. It may also be applicable to In-Depth Inspections depending on the objectives and scope of the In-Depth Inspection.

The overall asset condition rating (ACR)[2] reflects the overall condition of the asset, and is based on the component ratings assigned to the structural and non-structural components of the asset. The overall asset condition rating is calculated as a score out of 100 as follows:

$ACR = SR + FR$	$0 \le AR \le 100$	for all assets except for shorelines
$ACR = 4 \times FR$	$0 \le AR \le 100$	for shoreline assets

Where:

ACR = 100 corresponds to an asset in new or near new condition
0 corresponds to an asset in critical condition where structural integrity and functional use has been compromised

SR = Structural Component Combined Rating
= combined rating based on condition of structural components with a maximum score of 75. Includes deck, superstructure, substructure, and bulkhead components

FR = Functional Component Combined Rating
= combined rating based on condition of functional components with a maximum score of 25. Includes fender and mooring systems, joints, bearings, shoreline, and ancillary components

The upper bounds on the SR and FR contribution to the overall ACR score reflects the relative importance of the structural and non-structural components on the structural and functional adequacy of the asset. SR and FR are determined based on the applicable component ratings (defined in Section 6.2) as described in the following sections.

6.4.1. Determining Structural Component Combined Rating (SR)

The asset rating contribution from the structural components is determined as follows:

$$SR = 75 - (SP + SB + DK + BH) \ge 0$$

Where SP, SB, DK and BH are deductions based on their respective component ratings as defined in Table 6.5 below. The SR deductions are based on the following factors:

- Significance of component to the structural integrity of the asset
- Significance of component to the functional adequacy of the asset
- Ease of maintenance, repair, and/or replacement of component

6.4.2. Determining Functional Component Combined Rating (FR)

The asset rating contribution from the functional components is determined as follows:

$$FR = 25 - ([SL\_WS] + [JN\_BR] + FS + MR + SH + AC) \ge 0$$

[2] The ACR is similar in some ways to the AASHTO / FHWA Sufficiency Rating approach in the way it combines structural and functional considerations. However, unlike AASHTO / FHWA approach, the ACR defined here does not include any explicit consideration of capacity of the structure relative to current design criteria.

Where SL_WS, JN_BR, FS, MR, SH, and AC are deductions based on the non-structural component ratings as defined in the Table below. The SL_WS and JN_BR are combined ratings for the asset's Slabs or Wearing Surfaces, or Joints and Bearings. For the shoreline components group (SH) and the ancillary components group (AC), the component rating used for this calculation is an combined rating from all components within the component group for the asset in question (e.g., if the component rating for PM [paints and markings] is lower than all other AC component group ratings, the AC component rating may fall somewhere between the PM rating and the ratings of the other components). The FR deductions are based on the same factors as described for the SR deductions.

Table 6.5: SR Deduction Table

Component Rating	SR Deductions by Component			
	Super-structure (SP)	Sub-structure (SB)	Deck (DK)	Bulkhead (BH)
= 1	50	60	20	60
= 2	25	30	10	30
= 3	13	15	5	15
= 4	6	8	3	8
= 5	3	4	1	4
= 6	0	0	0	0

Table 6.6: FR Deduction Table

Component Rating	FR Deductions by Component					
	Slabs & Wearing Surfaces	Joints & Bearings	Fender System	Mooring System	Shoreline	Ancillary Comp.
	SL_WS	JN_BR	FS	MR	SH	AC
= 1	20	15	25	25	25	10
= 2	10	8	13	13	13	5
= 3	5	4	6	6	6	3
= 4	3	2	3	3	3	1
= 5	1	1	2	2	2	1
= 6	0	0	0	0	0	0

6.4.3. Example Calculations for Asset Condition Rating (ACR)

Sample calculations to determine the ACR for four hypothetical assets are shown in Table 6.7. The left-hand portion of the table lists the Component Ratings for the assets. The Component Ratings have been assumed for the purposes of this example, and would normally be assigned by the engineer as part of the condition assessment for the assets. Once the component ratings are known the asset condition rating (ACR) is calculated.

The process of determining the component deductions, structural component combined rating (SR) and functional component combined rating (FR) is illustrated below to calculate the ACR for Assets 1 and 2 from Table 6.7.

Table 6.7: Sample Asset Condition Rating Calculations

Components		Component Ratings					Deductions by Component			
Group	Type	Asset 1	Asset 2	Asset 3	Asset 4		Asset 1	Asset 2	Asset 3	Asset 4
Structural Components	Superstructure	3	6	5	4	SP	13	0	3	6
	Substructure	4	5	5	4	SB	8	4	4	8
	Deck	4	5	3	4	DK	3	1	5	3
	Bulkhead	5	5	4	2	BH	4	4	8	30
Non-Structural Components	Slabs & Wearing	NA	NA	NA	NA	SL_WS	0	0	0	0
	Joints & Bearings	4	6	4	4	JN_BR	2	0	2	2
	Fender System	2	6	4	2	FS	13	0	3	13
	Mooring System	5	6	5	5	MR	2	0	2	2
	Shoreline Comp.	NA	NA	NA	NA	SH	0	0	0	0
	Ancillary Comp.	3	5	5	4	AC	3	1	1	1
	Asset Rating	**52**	**90**	**72**	**35**	SR =	47	66	55	28
						FR =	5	24	17	7

Note: NA = component type not applicable to asset.

Calculation of ACR for Asset 1

The component ratings for the structural components are used to determine the structural component combined rating, SR. Using the component ratings for Asset 1 as listed in Table 6.7, the SR deductions are determined using Table 6.5 as follows:

Component	SR Deduction	Comments
Superstructure:	For component rating of 3, SP is 13	A component rating of 3 represents poor condition in a key structural component, resulting in a substantial deduction of 13.
Substructure:	For component rating of 4, SB is 8	While the ratings for these components are the same, the deduction for the deck (DK) is less. While the deck is structurally significant, this slightly lower deduction reflects the fact that deck repairs are more easily implemented, and thus have a slightly lower negative impact on the overall condition of the asset.
Deck:	For component rating of 4, DK is 3	
Bulkhead:	For component rating of 5, BH is 4	Minor deduction for component rating of 5 reflects satisfactory condition and limited impact on asset condition.

Calculate SR:

$$SR = 75 - (SP + SB + DK + BH) \geq 0$$
$$= 75 - (13 + 8 + 3 + 4)$$
$$= 47$$

The component ratings for the non-structural or functional components are used to determine the functional component combined rating, FR. Using the component ratings for Asset 1 as listed in Table 6.7, the FR deductions are determined using Table 6.6 as follows:

Component	SR Deduction	Comments
Joints & Bearings	For component rating of 4, JN is 2	A component rating of 4 represents fair condition; however the deduction is minor given the limited impact of JN on overall asset condition.
Fender System	For component rating of 2, FS is 13	A component rating of 2 represents serious condition where structural capacity or functionality may be compromised. Hence, deduction is substantial.
Mooring System	For component rating of 5, MR is 2	A component rating of 5 represents satisfactory condition, so deduction is minor.
Ancillary Components	For component rating of 3, AC is 3	A component rating of 4 represents fair condition; however the deduction is minor given the limited impact of AC on overall asset condition.

Note: there are no Bearing or Shoreline components in this asset (deductions are zero).

Calculate FR:

$$FR = 25 - (BR + JN + FS + MS + SH + AC) \geq 0$$
$$= 25 - (0 + 2 + 13 + 2 + 0 + 3)$$
$$= 5$$

Calculate ACR:

$$ACR = SR + FR$$
$$= 47 + 5$$

ACR = 52 for Asset 1

Calculation of ACR for Asset 2

Using the component ratings for Asset 2 as listed in Table 6.7, the SR deductions are determined using Table 6.5 as follows:

Component	SR Deduction	Comments
Superstructure:	For component rating of 6, SP is 0	A component rating of 6 represents new or minor damage condition, hence the deduction is zero.
Substructure:	For component rating of 5, SB is 4	While the ratings for these components are all 5, the deduction for the deck (DK) is less. While the deck is structurally significant, this slightly lower deduction reflects the fact that deck repairs are more easily implemented than repairs to the substructure or bulkhead, and thus have a slightly lower negative impact on the overall condition of the asset.
Deck:	For component rating of 5, DK is 1	
Bulkhead:	For component rating of 5, BH is 4	

Calculate SR:

$$SR = 75 - (SP + SB + DK + BH) \geq 0$$
$$= 75 - (0 + 4 + 1 + 4)$$
$$= 66$$

Using the component ratings for Asset 2 as listed in Table 6.7, the FR deductions are determined using Table 6.6 as follows:

Component	SR Deduction	Comments
Joints & Bearings	For component rating of 6, JN is 0	A component rating of 6 represents new or no damage condition, hence the deduction is zero.
Fender System	For component rating of 6, FS is 0	
Mooring System	For component rating of 6, MR is 0	
Ancillary Components	For component rating of 5, BH is 1	Minor deduction for component rating of 5 reflects satisfactory condition and limited impact on overall asset condition.

Note: there are no Bearing or Shoreline components in this asset (deductions are zero).

Calculate FR:

$$FR = 25 - (BR + JN + FS + MS + SH + AC) \geq 0$$
$$= 25 - (0 + 0 + 0 + 0 + 0 + 1)$$
$$= 24$$

Calculate ACR:

$$ACR = SR + FR \qquad = 66 + 24$$

ACR = 90 for Asset 2

6.4.4. Description of Overall Asset Condition

The numerical overall asset condition rating (ACR) may be used by the PHA to guide asset management and maintenance decisions. However, a single rating may not provide sufficient refinement or detail to properly guide decisions and recommended follow-up actions for all situations. Accordingly, the outcome of an inspection and condition assessment project must also include an overall qualitative description of the asset condition that addresses the following:

- Brief discussion of the ratings for all components of the asset;
- Discussion of the implications of the reported component ratings on the overall asset condition rating and recommended actions; and
- Discussion of recommended follow-up actions.

The combination of the asset rating and the narrative condition assessment will provide a more complete evaluation of the overall structural performance and adequacy of the asset.

CHAPTER 7: RECOMMENDED FOLLOW-UP ACTION GUIDELINES

7.1. General

Each inspection and condition assessment should include recommended follow-up actions as part of the inspection outcome. The recommended follow-up actions may include suggestions for maintenance, further investigation or immediate actions to remedy or avoid conditions that may compromise structural integrity or facility operations, or lead to property or environmental damage.

The recommended follow-up actions for the FICAP are presented in the following sections using five categories, ranging from no action required (i.e., "do nothing") to immediate (i.e., emergency) actions depending on the severity and implications of the conditions observed. More than one recommended action may arise from the condition assessment of a given asset. All actions should be prioritized in a consistent manner across all assets. In all cases, a brief justification should be provided for any recommended actions.

7.2. No Action Required

If the inspection and condition assessment does not indicate that any form of follow-up action (such as those described in the following sections) is required, the inspection recommendation is reported as "no action required" until the next routine inspection on the Follow-Up Action Form (see Chapter 8). The inspection and condition assessment team should provide the following for a recommendation of no action required:

- Recommendation for the timing of the next routine inspection. Depending on the condition rating determined during a routine inspection, the frequency of subsequent routine inspections may be adjusted (see Chapter 2). Final selection of inspection frequency will be made by the PHA.

7.3. Investigation Recommendations

The inspection and condition assessment of an asset may reveal conditions that require some form of follow-up action, but that do not represent an immediate action or emergency situation (see Section 7.6). These conditions or situations may include:

- Conditions requiring maintenance;
- Conditions requiring minor repairs;
- Conditions requiring replacement of one or more non-structural elements; and/or
- Elements where a condition state of CS4 (Severe) was assigned during the inspection.

Element condition state CS4 (Severe) represents the most severe condition of the element for the condition type in question. The CS4 condition may correspond to a reduction in structural capacity of a structural element, or a reduction in the functional performance of a non-structural element. Although the element condition state information is considered during the condition assessment process when assigning component ratings, the CS4 condition for an individual element warrants further review as a recommended follow-up action.

When a Routine, Baseline, Post-event or Due Diligence Inspection identifies conditions that require follow-up actions (other than Immediate Actions), the following information should be on provided on the Follow-Up Action Form (see Chapter 8):

- Classify the recommendation as ***priority*** or ***routine***:

  - Priority: The action to address the observed condition should take precedence over other actions (e.g., routine maintenance), but the condition needing repair does not appear to immediately compromise the structural integrity or functionality of the asset or element. Priority repairs may also be necessary to prevent further damage, deterioration, or defects from reaching the point at which future repairs become significantly more costly.
  - Routine: The action can be addressed as part of a routine maintenance program. Routine actions are those that can be scheduled in the future without compromising the structural integrity or functionality of the asset, and without significantly increasing the future cost of maintenance or repair.
- Provide a brief justification of the need for the action and the associated priority.
- Recommend whether or not an In-Depth Inspection (Section 7.4) is needed to properly identify the cause and implications of the damage, deterioration, or defects. The results of the additional inspection may be used to design an appropriate repair solution.

7.4. In-Depth Inspection

As discussed in Chapter 2, an In-Depth Inspection is not part of the scope of the FICAP Baseline and Routine Inspections. Rather, an In-Depth Inspection may be recommended as a follow-up action to a Baseline, Routine or Due Diligence Inspection in order to obtain the information required for the preparation of repair design and construction documents, or where atypical conditions have been identified that require more information to assess. An In-Depth Inspection is warranted where an Investigation was not able to identify the cause or significant of distress or deterioration. The recommendation for In-Depth Inspection should include:

- Description of the non-typical conditions and a brief written justification for the additional inspection, including an evaluation of its priority.
- Objective of the In-Depth Inspection. The objectives may vary, but some examples include:
  - Determine the cause or significance of deterioration;
  - Collect detailed condition and quantity information necessary to develop repair design; and/or
  - Confirm element and component geometry, details, and material properties necessary to verify or determine as-built conditions (where no existing as-built information is available) for asset inventory purposes, or as needed to conduct an Engineering Analysis for the purposes of load rating or as part of a structural upgrade.

The In-Depth Inspection may involve material sampling and analysis, nondestructive or destructive testing, and non-standard equipment and techniques beyond that used for Routine, Baseline, Post-Event or Due Diligence Inspections. Specialized testing and engineering knowledge and experience may be required to develop the inspection plan and to conduct the needed inspection. For underwater inspections, the In-Depth inspection will likely require all three inspection levels defined in ASCE 101 and may also include sonar imaging as necessary.

When an In-Depth Inspection has been conducted with the intent of determining the cause or significance of damage, deterioration, or defects and to collect the information necessary for the preparation of repair documents, the inspection and condition assessment team should recommend repairs with the following actions:

- Recommend repair actions and classify the repair recommendations as ***priority*** or ***routine*** as defined in the preceding section.
- Provide an engineer's cost estimate for repair activities.
- If included in the scope, provide a set of repair documents suitable for bidding the repair work. This may also be performed as part of follow-up engineering work.

It is assumed that in most cases, the scope of work for the In-Depth Inspection will be such that the recommended actions listed above can be completed without the need to recommend additional in-depth inspection. However, in some situations the objectives or outcomes of the In-Depth Inspection may require an Engineering Analysis to supplement the In-Depth Inspection findings. In this case, the need for an Engineering Analysis may be recommended as a follow-up action to an In-Depth Inspection.

7.5. Engineering Analysis

When an In-Depth Inspection identifies significant damage, defects, atypical conditions, or potential structural or functional concerns, an Engineering Analysis may be recommended. The recommendation for an Engineering Analysis should include:

- Brief written justification for the engineering analysis, including an evaluation of its priority.
- Objective of the engineering analysis, which may include any or all of the following:
  - Perform a structural evaluation (analysis) to quantify the structural capacity accounting for the effect of the observed defects or damage. This analysis may be required to determine if the structural integrity of the asset is at risk under the current conditions.
  - Assign a load rating for the asset.
  - Provide a service life analysis for the asset.
  - Evaluate the need for repairs or strengthening.
  - Develop an appropriate repair or strengthening solution.

The Engineering Analysis will normally be performed considering the actual or anticipated loads on the asset, which may be different from the original design loading for the asset. The design loading requirements should be determined in consultation with the Port of Houston Authority and the PHA Engineering Design Guide.

Note that an Engineering Analysis is not part of the scope of the FICAP Baseline and Routine Inspections, and is only conducted at the discretion and under the direction of the PHA. If included in the scope defined by the PHA, an Engineering Analysis may include preparation of a set of repair documents suitable for bidding the repair work.

7.6. Immediate Actions

Immediate actions are required when any inspection and/or condition assessment identifies severe conditions that have occurred, or appear likely to occur, that have the potential for property or environmental damage, or that may affect structural integrity or facility operations. Immediate actions are intended to be responses to extreme conditions or emergency situations, and are not intended to apply to conditions requiring routine maintenance or repairs.

Upon identifying conditions that have the potential for property or environmental damage, or that may affect structural integrity or facility operations, the inspection and condition assessment team shall take the following actions:

- The PHA Project Contact shall be notified immediately by phone with follow-up notification in writing to the PHA Project Contact within 24 hours.
- Provide a justification for the immediate response including a brief description and photographs of the condition(s) of concern.
- An In-Depth Inspection (Section 7.4) or Engineering Analysis (Section 7.5) may be recommended by the inspection and condition assessment team to further ascertain the extent and implications of the observed conditions, and to develop long-term repair and rehabilitation solutions to address the conditions and mitigate reoccurrence.

CHAPTER 8: DOCUMENTATION AND REPORTING

8.1. General

This section describes documentation and reporting requirements for the inspection and condition assessment program. Documentation and reporting is standardized to promote efficiency in inspection and reporting, enable comparison among assets, and provide for data storage and analysis via an asset database. A form-based reporting approach is used for most inspection types. Documentation begins with a standard asset description (Maritime Asset Inventory Record, or "Inventory Record Form"), and Standard Drawing Set. This information is intended to reflect persistent aspects of the wharf, which would only change if significant repairs or modifications are performed to the asset. The inspection documentation consists of four standard forms to report element-based inspection condition states and quantities, report inspection notes and photographs, summarize the condition assessment and document follow-up actions.

The following sections discuss the inspection forms and standard drawing requirements. Examples of an Inventory Record, Inspection Summary, Inspection History, Elemental Form, and Follow-up Action Form are provided in Appendix F. Finally, deliverables for each type of inspection and general record-keeping requirements are defined.

8.2. Inventory Record

The Inventory Record Form is a record document reflecting the as-built condition of the asset. The Inventory Record should be created as part of a Baseline Inspection and revised if changes are identified through a Routine or Special inspection. The Inventory Record should be updated after any modifications or significant repairs are performed.

The following information should be included as it pertains to each asset:

- **Identification** – Identification of the asset by the appropriate property/terminal and asset ID. These identifiers are coordinated with the Port of Houston Authority's GIS implementation.
- **Asset Classification and Type** – Categorization of the asset based on the asset type (e.g., wharf, boat dock, bulkhead, etc.). For wharves or boat docks, this also includes the generic type of construction (e.g. open or closed) and usage (e.g. break bulk, liquids, containers, etc.). Note that usage information is coordinated with the PHA.
- **Original Date of Construction –** The year when the asset was originally constructed.
- **Date(s) of Rehabilitation or Modification** –Year(s) of significant rehabilitation or modifications. Significant modifications are defined as work that alters the asset's footprint or changes structural components; this definition applies regardless of the percentage of asset being modified.
- **Inspection Frequency** – The designated frequency for Routine Inspections (set by PHA).
- **Geometric Data** – Pertinent asset dimensions, including plan dimensions, deck elevation, and channel depth.
- **Load Capacity** – The capacity of the structure relative to live loads. Live loads considered and defined by the PHA Engineering Design Guide include uniform loads, shore cranes, railroad, and truck loads. If available, the designed maximum vessel size for the fender and mooring systems should be listed. Does not apply to bulkheads or shoreline assets.

- **Asset History** – A narrative describing the history of the asset construction, repairs, and modifications. If known, the reason for structural modifications or repairs should be noted.
- **Reference Drawing List**– A list of existing drawings, titles, dates, and general scopes of work. At a minimum, drawings sets for original construction and any rehabilitation or should be listed, if available.
- **Components and Elements** – A list of components and elements comprising the asset. Components groups are categorized as structural, berthing, protection, shoreline, and other. For each component, applicable element types should be listed and briefly described. Component descriptions should include the location and extent of component on the asset. Descriptions of elements should include the material and typical geometric features, such as size, thickness, and span. If a standard component is not present on the asset, it should be listed with "none" as the description.
- **Figures** – Typical figures illustrating the location and configuration of the asset. At a minimum, these include the following: maps showing location of the facility relative to all PHA properties and a map marking the location of the asset within the facility; an aerial view illustrating the overall extent of the asset and marking adjacent assets; a typical, annotated partial plan; and a typical, annotated section. Multiple typical partial plans or sections may be warranted for assets with multiple configurations.
- **Revision History** – A table logging revisions to the document. This table is included because the inventory record is intended to be semi-permanent. The table shows the revision number, person, and date of the revision author, a date and person responsible for verification of the revision, and comments describing the reason for the revision.

8.3. Standard Inspection Drawings

Standard Inspection Drawings are created within the scope of the Baseline Inspection, and are used as a reference for Baseline, Routine, Due Diligence, and Post-Event Inspections. Drawings are important to present the layout of the structure, naming of bays, and identify types and locations of elements. Due to the long history of many of the maritime assets at the Port of Houston Authority, the current configuration of a particular asset may be the result of multiple alterations performed over the years, which may have been recorded in multiple sets of construction drawings.

Therefore, creating Standard Inspection Drawings has two main purposes. The first purpose is to create a schematic, cumulative as-built of the current configuration of the asset, which would then be verified as part of the field work in the Baseline Inspection. The second purpose is to define a consistent naming scheme for all elements of the asset, so that the Baseline Inspection and future inspections, modifications, and repairs can quickly and accurately identify and locate each element for documentation and reporting purposes.

Drawings should be created in accordance with the PHA CAD Standards in effect at the time of the Baseline Inspection. To provide uniformity between assets, the following should be used for plans and sections:

- Plans:
  - Orient asset with channel toward top of page, regardless of direction of true north.
  - Recommended scale: 1/8" = 1'-0"
  - In general, draw two plans: one upper level plan and one lower level plan.
- Sections:
  - Orient asset with channel on the right and landside on the left.
  - Recommended scale: 1/4" = 1'-0"

- Elevations:
  - Show elevation as viewed from water side.
  - Recommended scale: 1/8" = 1'-0"
  - Elevations are primarily intended to show berthing and fender system elements.

A Standard Inspection Drawing set consists of types of sheets shown in Table 8.1. A sample set of Standard Inspection Drawings, created for Wharf CD 41, is included as Appendix G.

Table 8.1. List of Standard Inspection Drawings

Sheet Number	Sheet Description	Information Included
G-001	Title	Asset name, PHA drawing number Date of drawing set Vicinity map Asset location map
G-002	Project Information	Sheet Index Key Plan, referencing asset plan sheets (i.e. G-1XX). The Key Plan should have notes/labels consistent with structure history on FICAP PHA Inventory Record form (i.e., indicate significant modifications, repairs, expansions, partial demolitions). List of Referenced Historical Drawings Definitions of Symbols Definitions of Abbreviations
G-10(x)	Bay Plan(s)	Plan view of topside of structure. Asset may be broken into multiple pages. Bays outlined and denoted per FICAP scheme (see Section 8.3.1). Grid lines, based on historic drawings if possible. Overall dimensions of bays. North Arrow Channel Designation
G-11(x)	Deck Element Plan(s)	Deck elements individually outlined and labelled.* Generally, consider a single deck element to incorporate all areas of similar construction in a given bay. A single deck element may have multiple spans. Drawn as a topside deck plan, with superstructure elements shown as hidden (dashed) lines.
G-12(x)	Superstructure Element Plan(s)	Superstructure elements individually labelled.* Drawn as a reflected deck plan, with substructure elements shown as hidden lines.
G-13(x)	Substructure Element Plan(s)	Substructure elements individually labelled.* Drawn as a plan of substructure elements cut below the deck level, with the deck and superstructure elements shown as thinner lines.
G-14(x)	Pile & Bulkhead Element Plan(s)	Piles individually labelled.* Bulkheads individually labelled.* Generally, consider bulkhead to extend between grid lines. Drawn as a plan of substructure elements with piles shown, with substructure elements shown as hidden (dashed) lines.

Table 8.1. List of Standard Inspection Drawings (cont'd)

Sheet Number	Sheet Description	Information Included
G-15(x)	Ancillary & Mooring Element Plan(s)	Ancillary elements individually labelled.* Mooring elements individually labelled* (where present deck topside). Drawn as a topside deck plan, with superstructure elements shown as hidden lines.
G-20(x)	Typical Sections	Cross-sections through representative portions of wharf. Include a separate cross-section for significant changes in structure configuration (i.e., change in pile type, arrangement of beams, width of structure, etc.). Provide elevations for Top of Deck; Mean Low Tide. Label typical elements with name and element code (e.g., RC Strut (ST-RC).
G-30(x)	Typical Elevations	Elevation of typical bay(s), as viewed from the channel. Include major structural members and energy-absorption units of fender system. Label typical elements with name and element code (e.g., RC Strut (ST-RC).

* See Section 8.3.2 for FICAP Element labelling and identification scheme

8.3.1. Bay Numbering Scheme

A standard bay numbering scheme has been developed for inspections and condition assessments conducted for the PHA. Bays are defined in the plan view as portions of the asset, typically extending from the water front to landside, and extending between numbered rows of piles or drilled shafts (grid lines). Bays should be numbered sequentially from upstream[3] to downstream. Where possible, the bay numbers should correspond with historical designations[4] and grid line numbers; if historical designations are inconsistent or unclear, grid line and bay numbering should start at 1 at the upstream extent of the asset and continue downstream. Where the structural system or framing changes significantly, such as might occur between original and landside extensions, bays should be split into sub-bays, with a letter added to the end of the bay designation (i.e., 1A, 1B, 1C). Figure 8.1 shows an example of this numbering scheme.

[3] As defined in Appendix B, "upstream" is the direction against the primary flow of the ship channel excluding tidal variance, which is generally from Galveston Bay toward the Turning Basin or downtown Houston. In Bayport and Barbour's Cut Terminals (which do not have large net flows) upstream is oriented away from their individual turning basins to the east.

[4] Historically, many of the wharves were constructed in groups contemporaneously and grid lines continued numbering from one wharf to another.

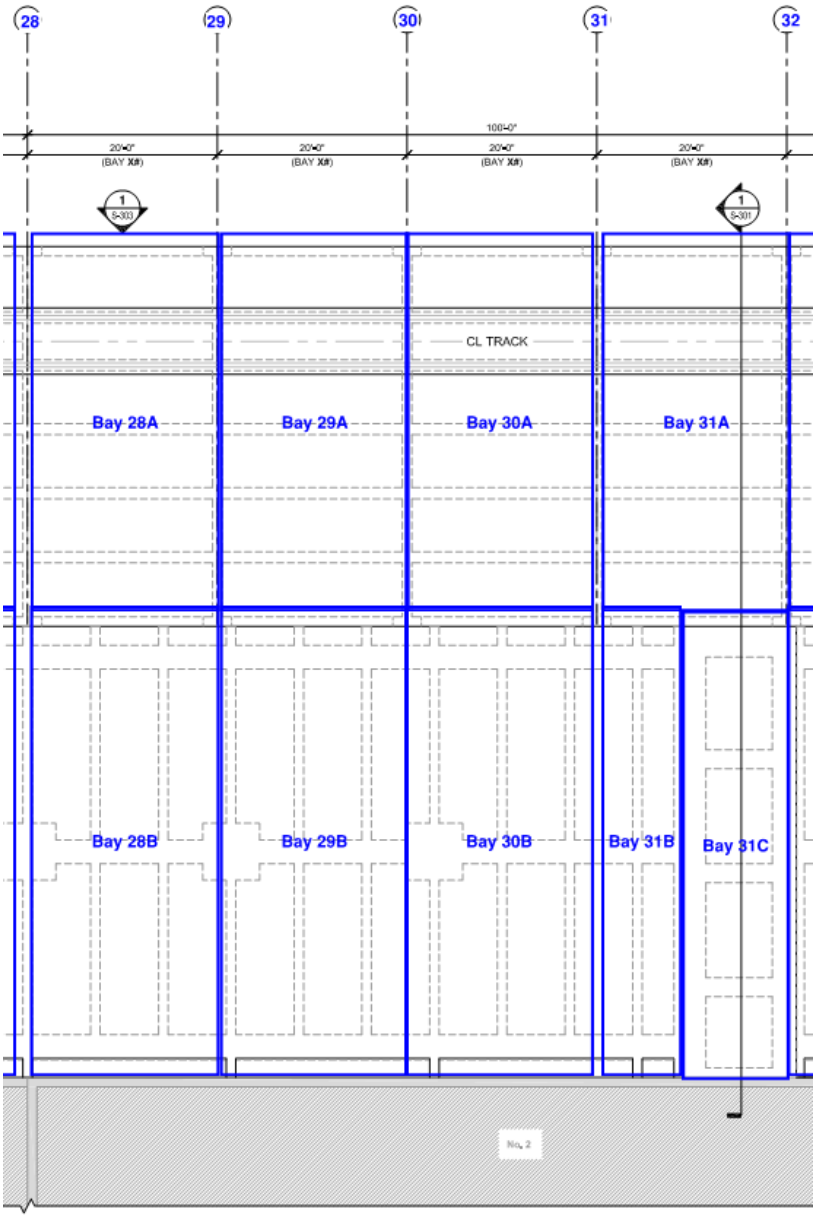


Figure 8.1: Figure illustrating numbering of bays for CD 41, a structure with significant change in framing between the original (Bays -A) and landside extension (Bays -B and -C).

8.3.2. Element Labeling Scheme

The nature of an element-based inspection and condition assessment approach is that each element of the asset that is included in a Baseline or Routine Inspection must be individually identified and labelled. A three-part Element ID labelling scheme has been developed for the purposes of uniquely identifying each element on the Standard Inspection Drawings. The Element ID is also used on the Element Inspection Form and in the FICAP database.

The Element ID labeling scheme is as follows:

AA #-#

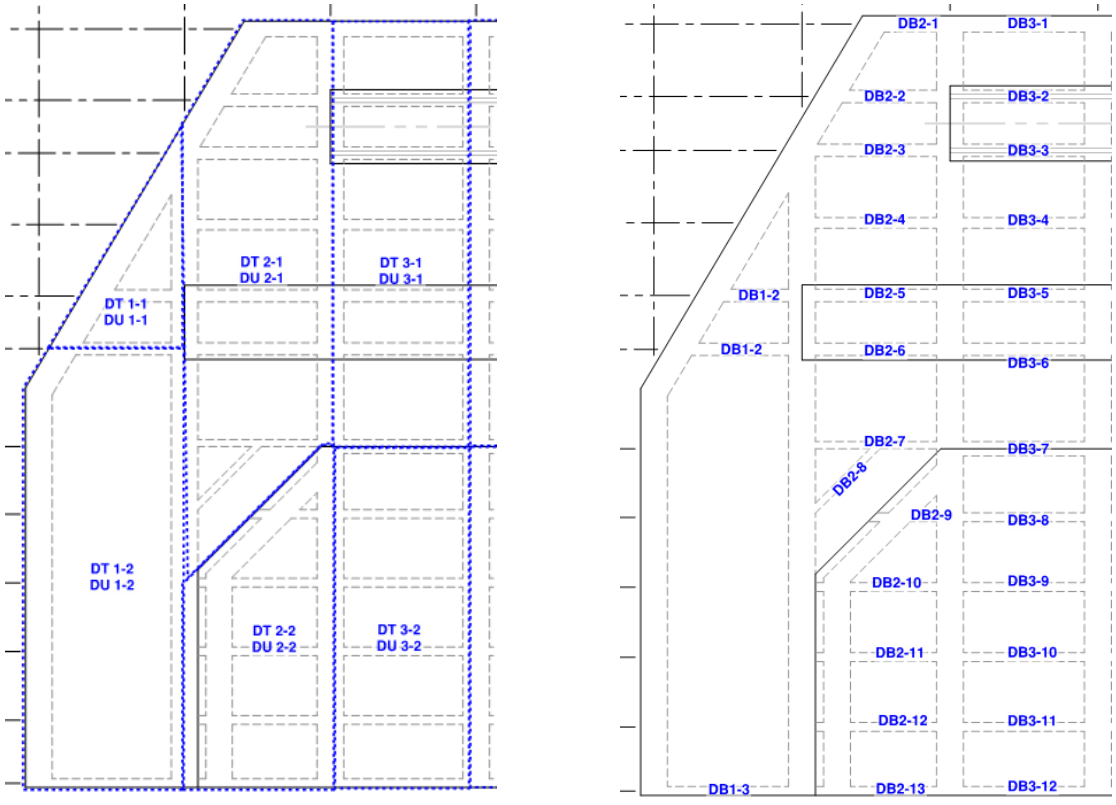
Element Code
DT, PI, WL, etc.
(see Section 3.2 and App. C)

Bay Number
1, 2A, 2B, etc.

Element Number
1, 2, 3, etc.

Elements should be numbered sequentially in each bay or sub-bay. Elements should start with 1 as the element closest to the upstream and water front, and increase in number moving downstream and then away from the waterfront. If elements fall on a grid or bay line, they should be generally be associated with the number of the bay or grid that is closer to the upstream end and water front. The downstream-most and land-side-most bays should include elements on their downstream and land side ends, respectively. See Figure 8.2 for an example of this naming scheme as applied to deck and superstructure elements.

The Element ID is supplemented by the Element Type Code presented in Chapter 3, where element types are defined by a two-part convention: AA-BB(B), where AA represents a two-letter element code, and BB(B) represents a two- or three-letter material type. This additional designation is used on the Element Inspection Form to indicate material type.



a) Deck Topside & Underside *b) Deck Beams*

Figure 8.2: Sample views of element designations from Wharf CD 41, showing definition for a) Deck Topside (DT) and Deck Underside (DU) elements, and b) Superstructure Deck Beam (DB) elements.

8.3.3. Designation of Elevations

Due to subsidence in the general Houston region, the elevation of a structure relative to the ship channel water surface may have changed since original construction. Consequently, historical drawings which made reference to Mean Low Water (MLW) or Mean Low Tide (MLT), Mean Sea Level (MSL), or other datums may no longer be accurate. The PHA publishes Wharf Characteristics regularly, which include elevations of each asset relative to MLW. This value shall be used for reference during inspections and shown on the Standard Inspection Drawings. If the value appears to be incorrect, a Follow-up Action should be created to re-survey the MLW elevation at the asset.

8.4. Inspection Summary

The Inspection Summary Form summarizes the findings of a Baseline, Routine, Due Diligence or Post-Event Inspection, including presenting the asset and component condition assessment findings. The Inspection Summary Form includes the following information:

- **Identification** – Identification of the asset by the property and asset ID. These identifiers are coordinated with the PHA's GIS implementation.
- **Inspection Information** – Type of inspection performed, date, scope, and personnel performing the inspection. Personnel performing the inspection should provide their qualifications in an attached roster.
- **Inspection Procedures** –Version of the Manual used for the inspection and any variances from the defined procedures.
- **Certification –** Statement certifying compliance of inspection with this manual and applicable building codes, and seal of responsible Design Professional.
- **Overall Asset Condition –** A narrative describing the asset's overall condition assessment and presenting the overall asset rating (see Section 6.4). Note significant areas of distress and reference action items for these as warranted. For Routine Inspections, note changes in condition from previous inspections. Representative conditions should be identified and shown in attached figures.
- **Component Rating and Element Summaries –** Tables of ratings for each component and type of elements. These tables match the components and elements provided in the Inventory Record.
- **Figures –** Representative photographs or figures of conditions for various components. All photos provided should be referenced in the narrative.

8.5. Inspection History

The Inspection History is a log of the inspections that have been performed for the asset. All inspections meeting the criteria in this Manual should be logged. This form contains the following information:

- **Identification** – Identification of the specific component and asset by the property and asset ID.
- **Date** – The month and year when the inspection was performed.
- **Inspection Type** – Baseline, Routine, Post-Event, In-Depth, or Due Diligence.
- **Inspection Prime Firm** – The prime firm performing the inspection. Sub-consultants (if used) are not listed on this form.

- **Component Rating Summaries and Overall Asset Condition**– A list of the component ratings resulting from the condition assessment, and the overall asset condition rating and qualitative descriptions. These values would only be entered for Baseline, Routine, or Due-Diligence Inspections.

8.6. Element Inspection Forms

Standardized Element Inspection Forms are applicable to Baseline, Routine, and Due Diligence Inspections. They may also be used as part of the deliverable for an In-Depth Inspection if appropriate. An example of these documents is provided in Appendix F. The use of these documents signifies that the inspection was performed in accordance with inspection requirements of this Manual. Inspection Forms include the recorded observations on an element-level basis for the asset and are intended to be the archival version of the inspection's field notes.

It is anticipated that separate inspection forms will be generated for each component. Inspection Forms should include the following information:

- **Identification** – Identification of the specific component and asset by the property and asset ID.
- **Component Summary** – A sum of quantified condition states for each type of element in the component.
- **Elemental Record** – For each element, identification of the element type, location, total quantity, and conditions observed. For each type of condition, quantify the area or length for each condition state. Each entry should include a unique element identifier, referenced from the Standard Inspection Drawing.
- **Photographs** – Photographs specific to a particular element or condition. Photographs are not required for each element or condition, but a sufficient number of photographs should be taken to show representative conditions. The photograph filename should be listed with the applicable element. Entries for the photograph may be abbreviated to the sequence number if unique identification of photographs is maintained. Requirements for photographs submitted to the project database with the inspection forms are as follows:
    - File Format: JPEG
    - Size: 2048 pixels on longest edge
    - Naming scheme: AssetID_InspectorFirstInitialLastName-YYYYMMDD_SeqNo.jpg [*example: Wharf09_JDoe_2016-07-28_2498.jpg*]

8.7. Follow-up Actions

The Follow-Up Action Form documents the recommended follow-up actions for Baseline, Routine, Due Diligence and Post-Event Inspections. Follow-up actions should be categorized as defined in Chapter 7, and should include a brief justification and a prioritization. Investigation Recommendations (as a follow-up action) may include maintenance or minor corrective actions that do not require an engineered design. The recommended follow-up actions should include photographs showing the conditions to be addressed where applicable. A sample Follow-up Action form is included in Appendix F.

8.8. Report Requirements

Baseline, Routine, Due Diligence and Post-Event Inspections have defined deliverables with standardized methods of reporting. Expected deliverables for each are listed in Table 8.2.

By their nature, In-Depth Inspections may have unique deliverables that do not fit standard templates. These deliverables may include technical reports, drawings, or other documentation. At a minimum, In-Depth Inspection deliverables should provide the following information:

1. Objective and scope.
2. Methodology, including reference to procedures or standardized test methods (e.g. ASCE, ASTM, AASHTO) as appropriate.
3. Record of observations and data, including field or laboratory data.
4. Interpretation of observations and data.
5. Recommendations.
6. Summary.
7. Seal of responsible Design Professional.

Table 8.2. Deliverables for Standard Inspections

Deliverable	Type of Inspection			
	Baseline	Routine	Post-Event	Due Diligence
Inventory Record	Yes. Includes initial generation of document.	Revise only if change identified	No	Revise only if change identified
Standard Inspection Drawing Set	Yes. Includes initial generation of document.	No	Marked-up Standard Drawing identifying extent of damage.	Revise only if change identified
Element Inspection Forms	Yes. Includes initial generation of document.	Yes. Relies on inspection forms generated by Baseline.	No	Yes. Relies on inspection forms generated by Baseline.
Inspection History	Yes. Includes initial generation of document.	Update	Update	Update
Inspection Summary	Yes	Yes	Yes[1]	Yes
Follow-Up Action Form	Yes	Yes	Yes	Yes
Submission into PHA database	Yes	Yes	Yes	Yes

[1]Use inspection summary form, but with Damage Rating from Post-Event Inspection (see Section 6.3 and Table 6.6)

8.9. Project Record Requirements

At the conclusion of the Inspection, deliverable documents should be submitted to the Project Manager in electronic format[5] via the PHA's MOSS system. After receipt and approval by the Project Manager, information from the Inventory Record, Inspection Forms (including referenced photographs), and Inspection Summary should be entered by the inspection firm into the PHA Asset Database as described in Section 8.10.

[5] Format of electronic documentation should be PDF/A-1 as defined by ISO 19005-1.

The inspection firm should maintain electronic records of the deliverable documents for a minimum of 4 years after submission. Unused photographs, paper notes, or other documentation not included in the project deliverables may be discarded after submission.

8.10. Inspection Database Requirements

PHA has developed a digital database to collect and report aspects of completed inspections. These inspections are to be submitted with a digital database template provided by PHA to the inspection firm, so that the digital data may be incorporated into the master database.

As shown in Figure 8.3, the digital inspection system is comprised of three tiers. The master database is maintained by PHA. All digital inspection information is housed there for analysis and reporting, as well as the ability to provide inspection firms historical inspection information at the start of their inspections. Firms will be provided a digital inspection database template in SQL database format (e.g. Microsoft Access) with basic forms to allow for data entry. While the data is not required to be directly entered into the digital database template, submission to the port is required to be in the exact SQL structure provided, as the data will be digitally be inspected then imported into the master database. Detailed instructions for use of the system will be provided with the digital database template. The methodology of collecting data in the field is left to the inspection firm.

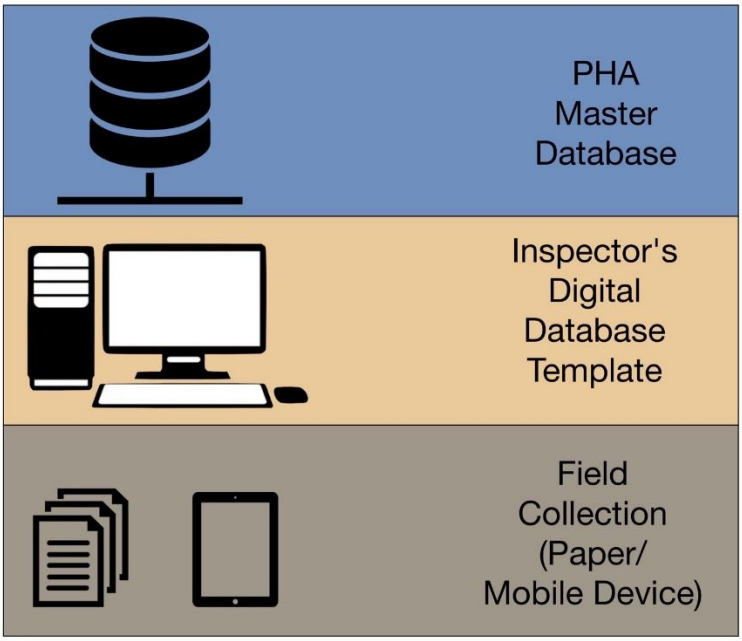


Figure 8.3. Digital inspection database hierarchy.

At the completion of the inspection, the inspection firm is required to transfer the required inspection documentation into the digital database template originally provided. This provides access to the required report forms to be submitted to PHA, as well to attach photographs and drawings utilized for the inspection. Contractor's should print the standard forms from the database, and review and certify that their findings are correctly entered. Printed versions of these forms should then be submitted as a part of the sealed engineering report.

CHAPTER 9: ADMINISTRATIVE REQUIREMENTS

9.1. Inspection and Condition Assessment Team Qualifications

The inspection and condition assessment of existing structures requires specialized knowledge and experience to ensure that the results of the evaluation are credible and repeatable, and provide the information necessary for the intended asset management purposes. The inspection and condition assessment of maritime or waterfront assets introduces additional complexities in terms of asset types and uses, exposure conditions, and the need for underwater inspection, and typically requires knowledge and experience different from that required for the evaluation of existing buildings, bridges, and other structures.

The inspection and condition assessment of maritime assets should be carried out by a team with the appropriate specialized knowledge and experience, including:

- Design, evaluation and repair knowledge specific to maritime assets including:
  - Design requirements specific to maritime structures.
  - Understanding of structural behavior and ability to interpret significance of observed damage, deterioration, or other deficiency on structural performance and integrity.
  - Repair methods for maritime components and elements.
- Visual, nondestructive, materials sampling, and testing techniques for assessing existing assets.
- Underwater inspection techniques and requirements.
- Degradation and aging mechanisms for concrete, steel, and timber structures.
- Methods and requirements for characterizing and quantifying damage and degradation.
- Inspection and condition assessment documentation and reporting requirements.
- Safety requirements for conducting above water and underwater inspections.

The scope and scale of an inspection and condition assessment of a maritime asset dictates that the work is conducted using a team approach. Each team member should have the training, knowledge, and experience necessary to conduct the aspects of the inspection and condition assessment for which they are involved or responsible. The intent of this document is not to dictate the specific makeup of an inspection and condition assessment team, but rather to propose a typical team structure and define required minimum qualifications for team members.

The typical project team structure consists of an Inspection and Condition Assessment Project Manager who oversees an on-site inspection team and a team of engineers responsible for conducting the condition evaluation. The same personnel may be involved in both the inspection and condition assessment if their qualifications are appropriate, or the two teams may be separate.

The following sections present minimum qualification requirements for the on-site inspection team and for the condition assessment team as a whole and for individual team members. The responsibilities and qualifications for the overall project manager are defined as part of the on-site inspection team, although this person is also responsible for the condition assessment portion of the project.

9.1.1. On-Site Inspection Team Composition and Qualifications

A typical organizational structure for an on-site inspection team is illustrated in Figure 9.1. Although the number of persons on a team may vary from project to project, the minimum number of personnel for the

on-site inspection should be one Team Leader and one Team Member for safety and practical reasons. Most inspection types will include some degree of underwater inspection. For illustration purposes, the inspection team is split into above water and underwater groups, although in practice some personnel may take part in both aspects of the inspection. The on-site inspection team structure shown in Figure 9.1 may apply to teams consisting of PHA personnel, consultants, or some combination thereof.

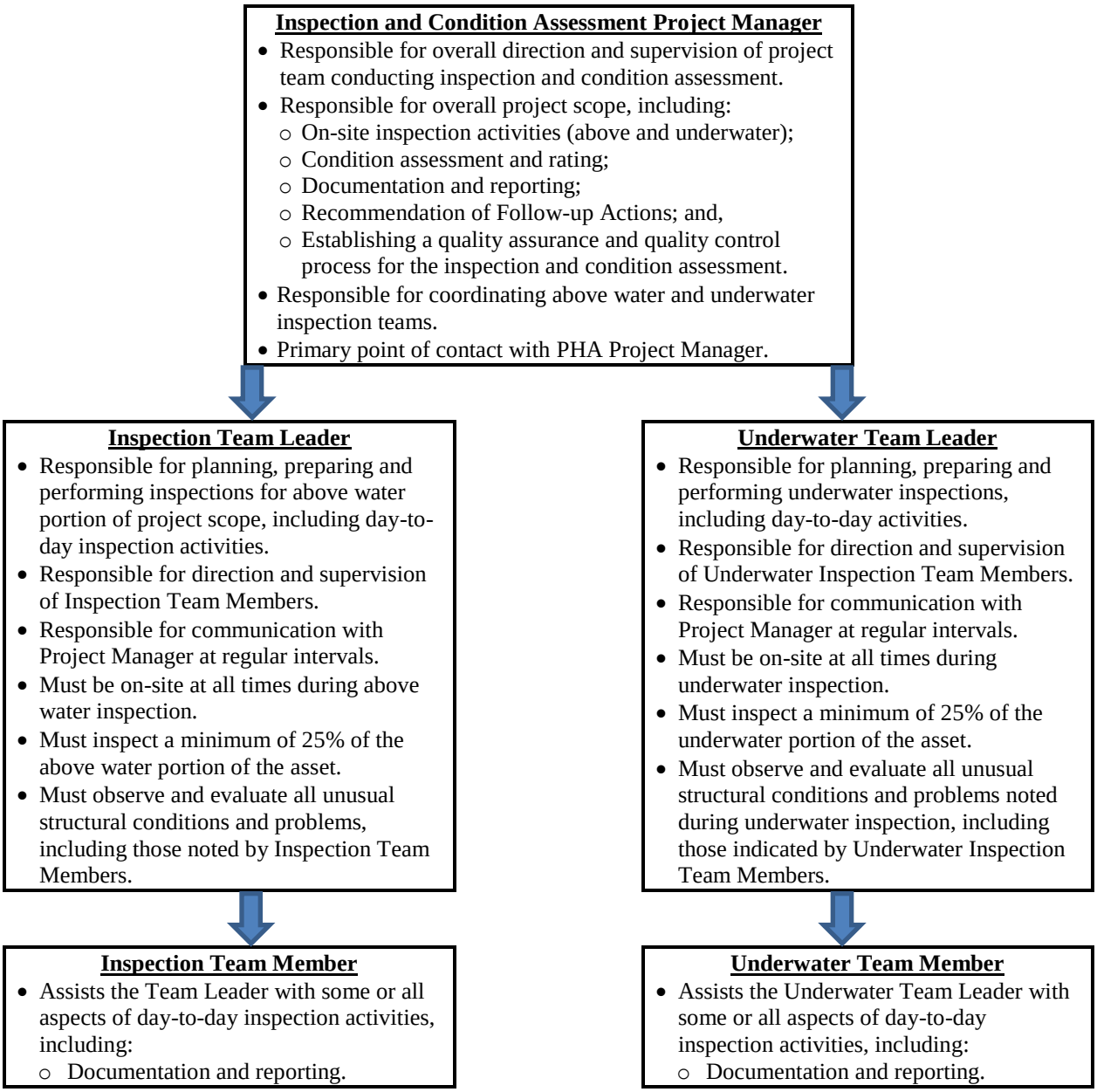


Figure 9.1: On-site Inspection Team Composition and Responsibilities

The minimum qualifications for the members of the on-site inspection team (Figure 9.1) are defined below. The PHA Director of Project and Construction Management may set higher or lower qualification

requirements on a project-specific basis. Post-event inspector qualifications will be at the discretion of the PHA Director of Project and Construction Management.

Inspection and Condition Assessment Project Manager	• Registered Professional Engineer licensed in the State of Texas. • Specialized in civil or structural engineering. • A minimum of 10 years of experience in the inspection, design and/or construction of civil structures, including maritime or waterfront assets. • Successfully completed the Port of Houston Maritime Facility Inspection Training Program.*
Inspection Team Leader	• Successfully completed the Port of Houston Maritime Facility Inspection Training Program.* Plus • Registered Professional Engineer. or • A minimum of 5 years of experience in inspection of civil structures, including maritime or waterfront assets.
Inspection Team Member	• Successfully completed the Port of Houston Maritime Facility Inspection Training Program.* Plus • Graduate of a four-year engineering curriculum in civil or structural engineering and certified as an engineer-in-training (EIT) or • A minimum of 2 years of experience in inspection of civil structures, including maritime or waterfront facilities.
Underwater Inspection Team Leader	• Same minimum qualifications as defined above for Team Leader. Plus • Hold diver certification from a recognized training organization (e.g., ADC accredited commercial, US Military, or PADI/NAUI dive school). • At least 5 years of commercial underwater inspection experience under conditions similar to the inspection site, which may include low visibility, high currents, and confined spaces.
Underwater Inspection Team Member	• Same minimum qualifications as defined above for Inspection Team Member. Plus • Trained commercial diver holding certification from a recognized training organization (e.g., ADC accredited commercial, US Military, or PADI/NAUI dive school).
Other Team Members	• Other personnel with lesser qualifications than those defined above may be present to perform manual tasks related to the above water inspection or to support diving operations.

*** Note:** Completion of the Port of Houston Maritime Facility Inspection Training Program is valid for a period of five (5) years, after which time the Training Program must be retaken.

9.1.2. Condition Assessment Team Composition and Qualifications

The condition assessment requires an engineering interpretation of the on-site inspection findings. Accordingly, the condition assessment team will largely consist of engineers. The structure for the condition assessment team is less formal than that of the on-site inspection team. The condition assessment team is led by the Inspection and Condition Assessment Project Manager as defined in the preceding section. Apart from the Project Manager, there are no specific requirements for condition assessment team composition or team member qualifications, except that all personnel involved with the condition assessment must have successfully completed the Port of Houston Maritime Facility Inspection Training Program.

9.2. Safety Requirements

Inspection of an existing asset presents numerous inherent safety risks for inspection personnel. Proper safety training and certification of inspection personnel is essential, as is continual awareness of safety concerns by all team members during the conduct of the inspection. Job safety must meet local and state regulations.

The Inspection Team Project Manager and the Inspection Team Leaders are responsible for providing safe working conditions during the inspection, including:

- Ensuring all Team Members have appropriate safety training in the application of safety procedures and use of safety equipment;
- Providing necessary safety equipment;
- Discussing safety procedures for each inspection task with Team Members; and,
- Enforcement of safety procedures and regulations.

Individual Inspection Team Members are responsible for their own safety and the safety of others, including:

- Knowledge of safety rules and regulations;
- Use of appropriate personal protection equipment and clothing;
- Safety of other Team Members (warn others of unsafe actions);
- Recognition of personal limitations (lack of knowledge or skill, physical limitations);
- Maintaining appropriate attitude and awareness during inspection (avoiding distraction and boredom, ignoring or not recognizing hazards, etc.); and,
- Reporting of accidents and injuries.

9.2.1. Port of Houston Authority Safety Policy

The Project Manager and all members of the Inspection Team must be familiar with the Port of Houston Health and Safety Policy, and must attend a Contractor and Consultant Safety Orientation before beginning work at Port Houston. Consultants and contractors shall abide by the tariff assigned to each terminal as outlined by the contract.

The Inspection Team is responsible for providing their own personal protection equipment, including:

- High Visibility Vest, required inside the terminal or conducting work adjacent to a road way.
- Hard Hats, required for work on the wharf, under wharf cranes, under Rubber Tire Gantry Cranes (RTG), in construction zones, or where an overhead hazard is present.
- Safety Footwear, required in a construction zone or where a foot hazard is present.
- Personal Floatation Device (Life Jacket), required for work over, under or near the water.
- Safety Glasses with ANZI Z87.1 rating with side shields, required for work in a construction zone or where an eye hazard is present.

Additional safety related requirements and practices will be addressed in the PHA Safety Orientation. In the event of a medical emergency, fire, vehicle incident, chemical spill, or chemical leak, the PHA Dispatch must be notified at 713-670-3611. Note that the current PHA Health and Safety Policy and the requirements of the PHA Safety Orientation will supersede the safety-related content in this Manual in the event of a discrepancy.

9.3. Other Administrative Requirements

Consultants and contractors shall comply with Security Requirements, Insurance, Limitation and Responsibility, and other issues as outlined by the contract.

CHAPTER 10: REFERENCES

10.1. Cited References

AASHTO. (2013). *Manual for Bridge Element Inspection.* Washington, DC: American Association of State Highway and Transportation Officials.

ASCE. (2001). *Practice No. 101 Underwater Investigations Standard Practice Manual.* (K. M. Childs Jr., Ed.) Reston, VA: American Society of Civil Engineers.

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10.2. Suggested References

The references below provide additional information on the subjects relevant to the FICAP program.

- Appendix B of ASCE 130: “Types and Causes of Defects and Deterioration”
- ACI CT-16, *ACI Concrete Terminology*
- ACI 224.1-R07, *Causes, Evaluation and Repair of Cracks in Concrete Structures*
- ACI 364.1R-07, *Guide for Evaluation of Concrete Structures before Rehabilitation*
- NAVFAC MO-322 (1993), *Inspection of Shore Facilities*
- NAVFAC MO-104.1 (1990), *Maintenance of Fender Systems and Camels*
- UFC 4-150-08 (2001), *Inspection of Mooring Hardware*

APPENDIX A - MARITIME ASSET LIST

FICAP - Marine Facilities/Asset List

List starts upstream on Northside of channel to downstream on Northside, and then upstream on Southside to downstream on Southside

Property or Terminal	Description
Northside Turning Basin	Shoreline of 21.4 acre undeveloped property upstream of UP Rail Bridge
Northside Turning Basin	Shoreline UP rail Bridge to Sam Houston Boat dock
Northside Turning Basin	Sam Houston Tour Boat dock and bulkhead
Northside Turning Basin	Shoreline from Sam Houston Bulkhead to Wharf 8 bulkhead
Northside Turning Basin	Fireboat Dock
Northside Turning Basin	Wharf 8
Northside Turning Basin	Wharf 9
Northside Turning Basin	Bulkhead between CD09 and CD 10
Northside Turning Basin	Wharf 10
Northside Turning Basin	Wharf 11
Northside Turning Basin	Wharf 12
Northside Turning Basin	Wharf 13
Northside Turning Basin	Wharf 14
Northside Turning Basin	Wharf 15
Northside Turning Basin	Wharf 16
Northside Turning Basin	Wharf 17
Northside Turning Basin	Wharf 18
Northside Turning Basin	Wharf 19
Northside Turning Basin	Wharf 20
Northside Turning Basin	Wharf 21
Northside Turning Basin	Wharf 22
Northside Turning Basin	Wharf 23
Northside Turning Basin	Wharf 24
Northside Turning Basin	Wharf 25
Northside Turning Basin	Wharf 26
Northside Turning Basin	Wharf 27
Northside Turning Basin	Wharf 28
Northside Turning Basin	Wharf 29
Northside Turning Basin	Wharf 30
Northside Turning Basin	Wharf 31
Northside Turning Basin	Bulkhead between CD 31 and CD 32 (under 610 Bridge)
Northside Turning Basin	Wharf 32 and shoreline (from downstream bridge 610)
Northside Turning Basin	Shoreline between CD 32 and USCG Station (future wharf 33 & 34)
Woodhouse Terminal	Woodhouse T-head Grain Wharf and shoreline
Woodhouse Terminal	Shoreline Westside of WH slip
Woodhouse Terminal	Old WH FireBoat Dock ~110' x 15' wood (abandoned)
Woodhouse Terminal	Northside of WH Slip, roro platform, + Wharf H3
Woodhouse Terminal	Wharf H2
Woodhouse Terminal	Channelside WH wharf H1
Greens Bayou	Shoreline along GB dredge site to Bulkplant bulkhead (NE end) part used for barge fleeting
Bulk Materials Handling Plant	Ship dock with Bulk gantry crane
Bulk Materials Handling Plant	T head dock
Bulk Materials Handling Plant	Channel side shoreline (future wharf space)

FICAP - Marine Facilities/Asset List

List starts upstream on Northside of channel to downstream on Northside, and then upstream on Southside to downstream on Southside

Property or Terminal	Description
BW8	3750' of channelside shoreline
Care Terminal	Bulkhead from West side of property line to JP-4
Care Terminal	Care Wharf 1
Care Terminal	Care Wharf 2
Care Terminal	Undeveloped Shoreline JP-5 to Inbessa on Southside of JP Slip (future HFOTC wharf?)
Jacinto Port Terminal	JP Wharf 1 from Westside slip to JP-2
Jacinto Port Terminal	JP Wharf 2 (middle wharf)
Jacinto Port Terminal	JP Wharf 3, has four spiralveyors)
Jacinto Port Terminal	Rail loading platform w/ 2 Rail tracks (~200'x26') w/ Access bridge
Banana Bend	BB Shoreline
Channelview	Old Fireboat dock West of Lost Lake Placement Area (USED FOR BARGE FLEETING)
Lost Lake DMPA	--
Lost Lake Barge Fleeting Area	ACL Barge Fleeting area south east corner of Lost Lake DMPA
Goat Island	--
Hog Island	--
Atkinson Island DMPA	--
Midbay DMPA	--
Evvia Island	--
Bolivar DMPA	--
Boliver	14000' of shoreline on NW side of GIWW barge channel
END OF DOWNSTREAM ON NORTHSIDE	
Southside Turning Basin	PHA shoreline upstream of CD 4
Southside Turning Basin	Wharf 4W and 4E
Southside Turning Basin	Wharf 3W and 3E
Southside Turning Basin	Wharf 2
Southside Turning Basin	Wharf 1W
Southside Turning Basin	Wharf 1E T-head pipeline Wharf
Southside Turning Basin	Wharf 41
Southside Turning Basin	Wharf 42
Southside Turning Basin	Wharf 43

FICAP - Marine Facilities/Asset List

List starts upstream on Northside of channel to downstream on Northside, and then upstream on Southside to downstream on Southside

Property or Terminal	Description
Southside Turning Basin	Wharf 44
Southside Turning Basin	Wharf 45
Southside Turning Basin	Wharf 46
Southside Turning Basin	Wharf 47
Southside Turning Basin	Wharf 48
Southside Turning Basin	Shoreline 48 downstream to edge of PHA property
Southside near Brady's Landing	Shoreline by bridge Across from Brady's Island
Manchester Wharves	Bulk headed shoreline from 610 bridge to upstream M2
Manchester Wharves	Wharf M2 - pipelines only
Manchester Wharves	Wharf M3 - liquid U-head dock
Manchester Wharves	Shoreline downstream of M3 to edge of PHA property
Sims Bayou	Shoreline Pipeline and Rail bridge area
Sims Bayou	Shoreline from rail bridge to Barge wharf cut
Sims Bayou	Barge Wharf + Shoreline
Sims Bayou	Tanker Wharf ! U-Head Tanker Dock + Shoreline
Albemarle lease	Shoreline associated with 1.67 acres filled submerged tract across from BMHP
Vopak Lease	Shoreline on 13.77 filled submerged acre tract (Across channel from Care)
Peggy Lake DMPA	--
BOSTCO Lease	PHA Shoreline Northside of Barnes Island
BOSTCO Lease	PHA Shoreline Northside of Barnes Island
San Jacinto Barge Dock	Barge Dock and Shoreline (leased to Lyondell Bassell)
Alexander Island DMPA	
Dupont Liquid Bulk Terminal	Barge dock and Shoreline
Spilman Island	Shoreline South of old tunnel access road and bridge, NW of SH146
Spilman Island	Bridge ~166'x58' Old access to Baytown tunnel
Spilman Island	Shoreline NW side of Spilman from PHA bridge to SH146 bridge property
Spilman Island	G&H Tugboat Dock
Spilman Island	Shoreline on Southwest side of PHA bridge property is for access to Spilman
Spilman Island DMPA	--
Barbours Cut	BCT dock 8-Enterprise barge dock and shoreline (to be converted to ship wharf)
Barbours Cut	BCT Wharf 7 (from BCT8 to diagonal bulkhead West of BCT 6)
Barbours Cut	Bulk head between BCT 7 and BCT 6
Barbours Cut	BCT Wharf 6

FICAP - Marine Facilities/Asset List

List starts upstream on Northside of channel to downstream on Northside, and then upstream on Southside to downstream on Southside

Property or Terminal	Description
Barbours Cut	BCT Wharf 5
Barbours Cut	BCT Wharf 4
Barbours Cut	BCT Wharf 3
Barbours Cut	BCT Wharf 2
Barbours Cut	BCT Wharf 1
Barbours Cut	BCT East Roro
Barbours Cut	BCT LASH Dock and Basin
Barbours Cut	BCT Fire Boat Dock (berths fro two Fire Boats)
Barbours Cut	Shoreline along HSC from LASH Basin through Ballaster road
Barbours Cut	Shoreline from Ballaster road around corner of property (stabilized area)
Barbours Cut	Shoreline along Galveston Bay 31.27 acre tract
Bayport	Shoreline on Northside o channel from entrance to SanJac College property
Bayport	Shoreline Northwest corner of BPT Turning Basin
Bayport	Shoreline adjacent to PHA's Western first flush pond
Bayport	Future Bayport Wharf 7
Bayport	Future Bayport Wharf 6
Bayport	Bayport Wharf 5
Bayport	Bayport Wharf 4
Bayport	Bayport Wharf 3
Bayport	Bayport Wharf 2
Bayport	Future Bayport Wharf 1
Bayport	Bulkhead along BPT Channel North of Cruise
Bayport	Bayport Cruise Wharf
Bayport	Bayport Cruise Basin
Bayport	Shoreline South of Bayport Cruise along Galveston Bay
Pelican Island	Shoreline on West side of Pi just north of TAMUG
Pelican Island	Shoreline North of Sea Wolf Park
Pelican Island	Shoreline along Galveston Channel from Seawolf park to west end of shore property

APPENDIX B - GLOSSARY

Item	Definition	Alternate Names (deprecated)	Reference
Apron	Portion of paved area adjacent to waterfront. For PHA assets, this may include both structural deck and slabs on grade.		
Beam	A structural member subjected primarily to flexure but may also be subjected to axial load.		*ACI CT-16*
– **Deck Beam**	Beam directly supporting or contiguous with wharf deck.	*Stringer*	
– **Frontal Beam**	The first beam at the front of the wharf, contiguous with the wharf deck.	*Spandrel Beam* *Marginal Beam* *Fender Beam*	
– **Wale Beam**	A horizontal member used for bracing the sheeting or trench, cofferdam, bulkhead, or similar structures	*Waler*	*ASCE 130*
Berth	A place to dock a vessel.		
Bitt	Similar to a **bollard**, a vertical post used to secure mooring lines. **Bitts** are usually installed in pairs.		*ASCE 130,*
Bollard	Cast steel cylindrical capped head extending up from a base plate for fastening ships to piers. See also **cleat**.		*ASCE 130*
Brace	An element, either horizontal or diagonally oriented, fastened across pile elements to provide lateral stability. Usually located in timber or steel maritime structures. For concrete structures, see also **strut**.		
Brace Wall	See **shear wall**		
Camel	Compression member used to offset a wharf or dolphin from a ship. Camels typically float freely in elevation with the tide.		
Channel Side	The side of the structure facing the **ship channel**.	*Harbor Side* *Water Side*	
Condition Assessment	An evaluation of inspection results to provide an appraisal of the significance of the observed damage and deterioration on the condition of the structure.		
Cleat	A wood or metal fitting usually with two projecting horns around which a rope may be made fast; a piece fastened to or projecting from something and serving as a support or check. See also **bollard**.	*Cavil* *Kevel*	*ASCE 130*
Curtain Wall	A short, typically reinforced concrete wall on the landside of a structural deck for the purpose of retaining soil. Unlike retaining walls, a curtain wall does not extend deep into the ground and relies on the deck for support at the top.		
Damage	**Distress** caused by an external event.		
Deterioration	(1) physical manifestation of failure of a material (for example, cracking, delamination, faking, pitting, scaling, spalling, and staining) caused by environmental or internal autogenous influences (2) decomposition of material during either testing or exposure to service.		*ACI CT-16*

Item	Definition	Alternate Names (deprecated)	Reference
Defects	An anomaly in a material or element present since original construction.		
Distress	**Deterioration**, distortion, or displacement to an element as a result of external forces or material deterioration.		
Datum	A reference elevation plane.		
Deadman	An anchor, usually a beam, block, or other heavy item, buried in the ground, to which a line is attached		*ACI CT-16*
Dock	A self-supporting structure for berthing and unloading cargo or passengers, typically for smaller vessels or barges. See also **wharf**.		
Dolphin	A free-standing, pile-supported or solid-filled structure used for mooring and berthing vessels, protection of the end of piers or wharves, turning ships, or protection of bridge structure.		*ASCE 130*
Downstream	The primary direction of the channel flow, excluding tide changes, which is toward Galveston Bay. In Bayport and Barbour's Cut Terminals (which do not have large net flows) downstream is oriented toward the west in order to be consistent with original grid lines and naming schemes. See also **upstream.**		
Fender System	Devices used on the face of a pier, wharf, or dolphin to protect the ship and shore facility from damage due to contact between the two during berthing and mooring. Fenders may be energy-absorbing, or simply transmit forces directly to the structure behind. Fenders are usually designed for specific ranges of vessels. The fender system may be comprised of some or all of the pieces below.	*Fendering System*	
– **Facing**	Sacrificial elements fastened to the harbor side of the fender system for the purpose of providing low-friction surfaces and protecting both ships and other fender elements from abrasion damage. Facing includes ultra-high molecular-weight (UHMW) panels, plastic rub strips, and timber logs.	*Rub Strips* *Lagging*	
– **Fender Unit**	Energy-absorbing devices used on the face of a pier, wharf, or dolphin to protect the ship and shore facility from damage due to contact between the two during berthing and mooring.	*Damper*	
– **Panel**	A rectangular element oriented parallel to the fender system that increases the contact area of the fender system against the ship hull.		
– **Pile**	A vertical element that absorbs energy through bending of the member. Fender piles are typically driven into the channel bed and braced at their top.		
– **Secondary Framing**	Includes bracing, struts, chocks, or other secondary structural framing members of a fender system. Secondary members generally add to the stability of the fender system and do not distribute berthing and mooring forces.		

Item	Definition	Alternate Names (deprecated)	Reference
– **Stay Chains**	Heavy-duty chains connecting between wharf structure and other fender elements. Chains types include weight chains (to restrain vertical movement), shear chains (to restrain lateral movement), tension chains (to restrain rotation in cantilevers), and keep chains (for lifting or replacing fender elements).		
– **Wale Beam**	A member that runs horizontally along the length of the fender system and distributes berthing and mooring forces to other elements.		
Fittings	Elements used for mooring ships, including **bitts**, **bollards**, and **cleats**.		
Floor Beam	A beam element that carries vertical loads from a deck or system of stringers to a system of girders (typically perpendicular to the floor beam).		*BIRM*
Functionality	The use for which a particular element or component is designed. Functionality can usually be defined simply, such as "provide access to a lower level" (e.g., ladder), or "provide anchorage for mooring line and resist mooring force" (e.g. **cleat**)		
Girder	A large beam element, usually horizontal, that serves as a main structural member and usually supports one or more Beams. A large floor beam (i.e., depth greater than 36 inches) could also be considered a girder, particularly if it is a built-up section.		*ACI CT-16*, *BIRM*
Grid Line	A line used for layout on inspection drawings.	*Column Line*	
Houston Ship Channel	The navigable waterway existing from the Galveston Sea Buoy to the Houston Turning Basin		*Houston Pilots*
Inspection	An evaluation procedure in which a qualified investigator observes, classifies, and documents the physical condition of a structure. It may involve visual, tactile, nondestructive testing and material sampling and testing methods to determine the types, severity and locations of deterioration or distress in the structure. An inspection is a key step in the condition assessment of a concrete structure		
Jetty	A structure that projects into the water to prevent the formation of sandbars, normally located near harbor entrances and river estuaries.		*ASCE 130*
Land Side	The face of the structure parallel to and farthest away from the Ship Channel.	*Shore*	
Lay Berth	A Wharf or location used primarily for temporary mooring of ships where no loading or unloading takes place.		

Item	Definition	Alternate Names (deprecated)	Reference
Load rating	The load-carrying capacity of an existing structure determined in accordance with the governing code or standard for design or evaluation. Load rating is determined by analysis, and normally incorporates knowledge of the as-built condition and an evaluation of current structural conditions based on an inspection of the structure.		
Marine	Pertaining to the sea. For this manual, this includes the Ship Channel, which is brackish water.		
Maritime	Pertaining to structures on a shoreline, including rivers, bays, and oceans.		
Pilaster	A thickened portion of a wall, usually for carrying additional axial load or providing out-of-plane stiffness. Often reinforced internally like a column, with longitudinal bars and ties. See also **plinth**.	*Plinth*	
Plinth	A thickened portion of a wall or column, primarily for the purpose of spreading load.		
Property	The highest level in the hierarchy from an inspection and condition assessment perspective (higher levels may be considered for asset management or other purposes). It is typically comprised of a group of assets and is defined by distinct boundaries. A **property** is a collection of non-cargo assets. See also **terminal**.		
Strut	A member spanning between piles or pile bents for the primary purpose of bracing the top of the piles or pile caps from lateral movement.	*Lower Beam* *Brace Beam* *Tie Beam*	
Terminal	The highest level in the hierarchy from an inspection and condition assessment perspective (higher levels may be considered for asset management or other purposes). It is typically comprised of a group of assets and is defined by distinct boundaries. A **terminal** is a collection of cargo-wharf assets. See also **property**.		
Tidal Datums	Standard elevation defined by a certain phase of the tide. Tidal datums are used as references to measure local water levels and should not be extended into areas having differing oceanographic characteristics without substantiating measurements. In order that they may be recovered when needed, such datums are referenced to fixed points. In the **Houston Ship Channel**, tide heights are mixed (both diurnal and semidiurnal). The tide cycles generally through a high and low twice each day, with one of the two high tides being higher than the other and one of the two low tides being lower than the other. See Figure 1 and Figure 2.		*NOAA*

Item	Definition	Alternate Names (deprecated)	Reference

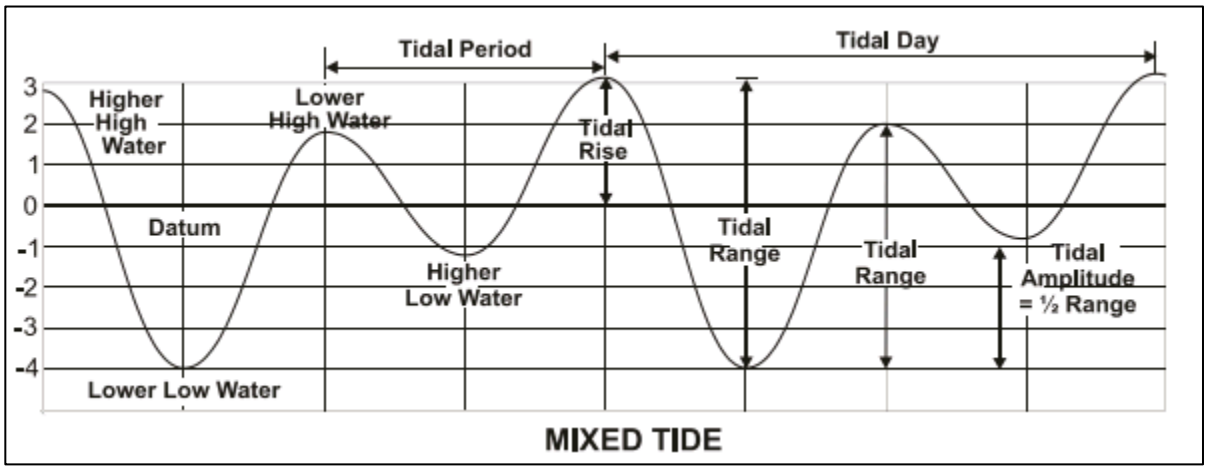

Figure 1. Schematic of tidal cycle with tidal terminology. The zero on the graph is illustrate of the relationship of tide to Mean Seal Level. Figure from [NOAA Special Publication NOS CO-OPS 1](#).

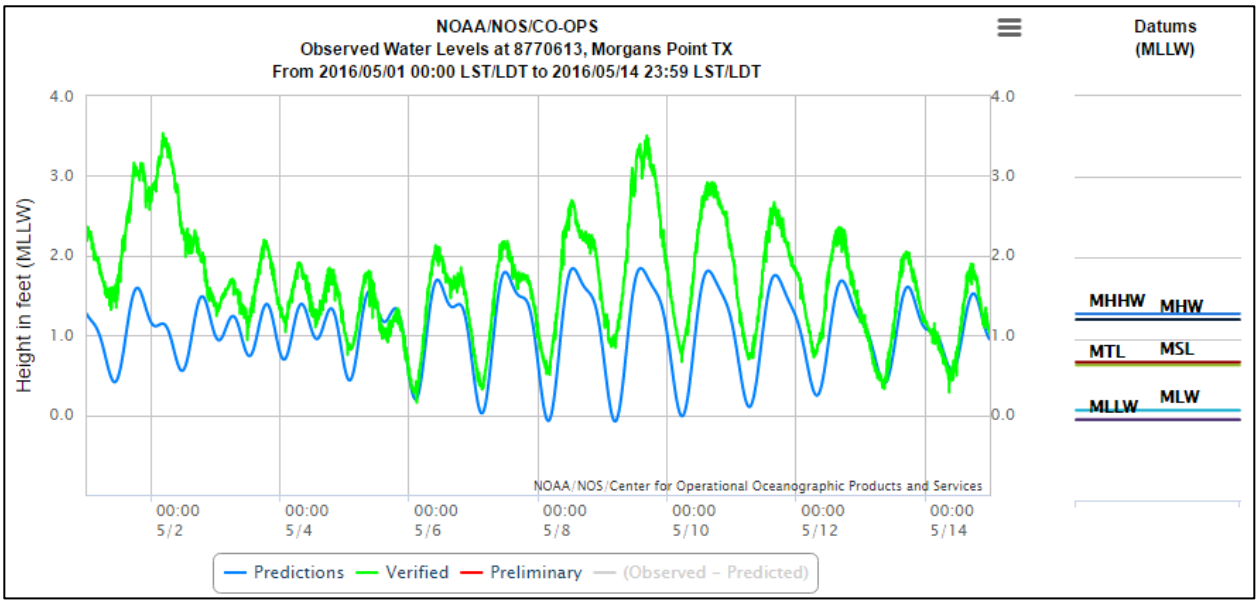

Figure 2. Example of observed and predicted water levels relative to MLLW at Morgans Point. Relative height of datums at this station are shown on the right.

– **MHHW (Mean Higher High Water)**	The average of the higher high water height of each tidal day observed over the **National Tidal Datum Epoch**.		*NOAA*
– **MHW (Mean High Water)**	The average of all the high water heights observed over the **National Tidal Datum Epoch**.	*MHT (Mean High Tide)*	*NOAA*

Item	Definition	Alternate Names (deprecated)	Reference
– **MLW (Mean Low Water)**	The average of all the low water heights observed over the **National Tidal Datum Epoch**.	*MLT (Mean Low Tide)*	*NOAA*
– **MLLW (Mean Lower Low Water)**	The average of the lower low water height of each tidal day observed over the **National Tidal Datum Epoch**.		*NOAA*
– **MSL (Mean Sea Level)**	The arithmetic mean of hourly heights observed over the **National Tidal Datum Epoch**. Shorter series are specified in the name; e.g. monthly mean sea level and yearly mean sea level.		*NOAA*
– **MTL (Mean Tide Level)**	The arithmetic mean of mean high water and mean low water.		*NOAA*
– **National Tidal Datum Epoch**	The specific 19-year period adopted by the National Ocean Service as the official time segment over which tide observations are taken and reduced to obtain mean values (e.g., mean lower low water, etc.) for tidal datums. It is necessary for standardization because of periodic and apparent secular trends in sea level. The present NTDE is 1983 through 2001 and is actively considered for revision every 20-25 years. Tidal datums in certain regions with anomolous sea level changes (Alaska, Gulf of Mexico) are calculated on a Modified 5-Year Epoch.		*NOAA*
– **NAD27**	North American Datum of 1927		*NOAA*
– **NAD83**	North American Datum of 1983		*NOAA*
– **NAVD 88**	North American Vertical Datum of 1988		*NOAA*
– **N.D.D.**	Navigation District Datum; a historical Port of Houston Authority-defined datum, appearing on many historical drawings. Shown as +1.45’ relative to U.S.E.D. at Wharf 26 to 28 (ref C126-2 Sheet 3).		*NOAA*
– **Station Datum**	A fixed base elevation at a tide station to which all water level measurements are referred. The datum is unique to each station and is established at a lower elevation than the water is ever expected to reach. It is referenced to the primary bench mark at the station and is held constant regardless of changes to the water level gauge or tide staff. The datum of tabulation is most often at the zero of the first tide staff installed.		*NOAA*
– **U.S.E.D.**	Unknown abbreviation; appears on many historical drawings. Shown as -1.39’ relative to PHA datum on 1970s hand-drawn wharf plans.		
Photogrammetry	The science of making measurements from photographs.		
Pier	A structure that projects from the shore, oriented perpendicular, or at an angle to the shore. See also **wharf**.		*ASCE 130*

Item	Definition	Alternate Names (deprecated)	Reference
Pilaster	A columnar element coinciding with a wall.		
Pile	A vertical element partially embedded in soil and partially exposed to water. Portions may be exposed above water. Piles are prefabricated from wood, steel, concrete-filled steel tubes, or timber materials and driven into the soil.		
Pile cap	A member connecting pile heads and through which loads are transmitted to the piles		*ASCE 130*
Rehabilitation	The process of repairing or modifying a structure to its original, as-built condition, or to another desired useful condition.		
Repair	The action of replacing or correcting deteriorated, damaged, or faulty materials, components, or elements of a structure.		
Shear Wall	A wall, typically transverse to the front of the wharf, spanning between the **pile cap** and superstructure.	*Brace Wall*	
Slip	A berthing area between two parallel adjacent waterfront structures.		
Stringer	A beam element that carries vertical loads from a deck to a system of floor beams (typically perpendicular to the stringers).		*BIRM*
Strut Beam	See **brace beam**		
Upstream	The direction against the primary flow of the **ship channel** excluding tidal variance, which is generally from Galveston Bay toward the Turning Basin or downtown Houston. In Bayport and Barbour's Cut Terminals (which do not have large net flows) upstream is oriented toward their individual turning basins to the west. See also **downstream**.		
Tieback	A rod fastened to a deadman, a rigid foundation, or either a rock or soil anchor to prevent lateral movement of formwork, sheet pile walls, retaining walls, and bulkheads.		
Vessel Capacity			*ASCE PORTS 2016 Vessel Berthing and Mooring Course*
– **BBL**	Barrel, equivalent to 42.5 US gallons. Usually used for oil-carrying vessels.		
– **CM**	Cubic Meter, for liquefied natural gas vessels.		
– **DT**	Displacement Tonnage – actual weight of vessel at given draft, usually at full load.		
– **DWT**	Dead Weight Tonnage – cargo carrying capacity of vessel. Usually reported in metric **tonnes** or **long tons**		
– **GRT**	Gross registered tons – total enclosed space in vessel.		
– **Long Ton (LT)**	Traditional maritime displacement unit in USA, equal to 2,240 lbs.		

Item	Definition	Alternate Names (deprecated)	Reference
– **LWT**	Light Weight Tonnage – actual weight of vessel without cargo, fuel, and stores.		
– **NRT**	Net Registered Tons – space available for passenger or cargo. Reported in terms of volume, see **Registered Ton.**		
– **Registered Ton (RT)**	A unit of volume equal to 100 cubic feet.		
– **Short Ton (ST)**	Measure of force equal to 2,000 lbs. Often used for mooring hardware and equipment capacity.		
– **TEU**	Twenty-foot equivalent unit, typically used for container ships. TEU is only defined in terms of exterior length and width and can vary in height. Typical size for a 20-foot TEU is 20 ft by 8 ft by 8 ft 6 in (L×W×H), with a volume of 1,360 cu. ft. "High cubes" are 9 ft 6 in high, and "half height" cubes are 4 ft 3 in high.		
– **Tonne (MT)**	Metric unit, equal to 1000 kg (2205 lbs) of mass		
Wharf	A structure, partially supported on land and oriented approximately parallel to shore, where ships can be moored at the offshore face. See also **pier**.	*Quay*	*ASCE 130*
Wharf Logs	A timber member anchored to the front edge of a deck for the purpose of preventing vehicles from rolling off the edge.	*Bullrail* *Curb*	

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APPENDIX C – ELEMENT DESCRIPTIONS

Table 3.1. Basic Material Types for Structural Elements

Material		Abbreviation	Description
Concrete	Reinforced Concrete	RC	Conventional, reinforced, cast-in-place concrete
	Precast Concrete	PCC	Conventionally reinforced concrete that is cast off-site and then installed on the structure.
	Prestressed Concrete	PSC	Reinforced concrete with bonded or unbonded prestressing tendons. Elements may be precast or cast-in-place, and pre- or post-tensioned.
	Unreinforced (Plain) Concrete	UC	Concrete without reinforcement.
	Bituminous	BM	Bituminous (asphalt) paving or patching material, typically used as wearing surfaces.
Metals	Steel	CS	Carbon steel materials. Typically coated or painted for corrosion protection.
	Stainless Steel	SS	Stainless steel materials. Stainless steels have a minimum of 10.5 percent chromium.
	Galvanized Steel	GS	Carbon steel that has been hot-dip galvanized with zinc.
	Metals (all other)	MT	Metals that do not fall into any of the other categorized. Includes aluminum, cast iron, ductile iron, etc.
Other	Timber	TIM	Rough, sawn, or engineered wood
	Rubber	RB	Rubber or elastomeric materials.
	Other materials	OTH	All other materials that do not fit in any of the predefined categories.

Note: Table 3.1 repeated here for reference.

Table C-1. Structural Component Elements			
Element Code(s)	**Element Descriptor**	**Element Identification**	**Units**[1]
Deck Elements (DK)			
DT-RC DT-PCC DT-CS DT-TIM DT-OTH	RC Deck Topside PCC Deck Topside CS Deck, Open Grid TIM Deck Topside OTH Deck Topside	A horizontal, planar structural element that carries and distributes loads to superstructure or substructure elements. Observations specific to topside of element.	SF
DU-RC DU-PCC DU-TIM DU-GS DU-OTH	RC Deck Underside PCC Deck Underside TIM Deck Underside GS Deck (stay-in-place form) OTH Deck Underside	A horizontal, planar structural element that carries and distributes loads to superstructure or substructure elements. Observations specific to underside *or* full-depth of element.	SF
DR-RC	RC Deck Drop Panel	A thickened portion of a deck over a columnar structural element below.	EA
BO-RC BO-UC	RC Bonded Overlay UC Bonded Overlay	Concrete material cast on top of and bonded to a deck surface.	SF
TF-PCC TF-PSC	PCC Top Flange PSC Top Flange	Top flanges of girders or beams where live loads are applied directly on the structural element.	SF
Slab and Wearing Surface Elements (SL & WS)			
SL-RC SL-UC SL-BM	RC Slab on Grade or Fill UC Slab on Grade or Fill BM Slab on Grade or Fill	A horizontal structural element that carries and distributes loads to the soil or subgrade. Does not include relieving platforms. Includes approach slabs and slabs over fill that may be supported by structural decks below.	SF
WS-RC WS-UC WS-BM	RC Wearing Surface UC Wearing Surface BM Wearing Surface	Wearing materials generally 1/4-inch in thickness or greater on a deck or slab surface. Includes asphalt (bituminous) overlays and unbonded concrete topping slabs.	SF
Superstructure Elements (SP)			
DB-RC DB-PCC DB-PSC DB-CS DB-GS	RC Deck Beam PCC Deck Beam PSC Deck Beam CS Deck Beam GS Deck Beam	A structural element loaded perpendicular to its longitudinal axis that transmits loads directly from the deck to a girder or substructure element.	LF
BG-PCC BG-PSC BG-CS	PCC Closed Web/Box Girder PSC Closed Web/Box Girder CS Closed Web/Box Girder	A hollow, four-sided structural element loaded perpendicular to its longitudinal axis that transmits loads from a deck beam or stringer to the substructure.	LF

[1] SF = square foot, LF = linear foot, EA = each

Table C-1. Structural Component Elements			
Element Code(s)	**Element Descriptor**	**Element Identification**	**Units[1]**
Superstructure Elements (SP)			
GI-RC GI-PCC GI-PSC GI-CS GI-GS	RC Girder PCC Girder PSC Girder CS Girder GS Girder	A structural element loaded perpendicular to its longitudinal axis that transmits loads from a deck beam or stringer to the substructure. May also carry loads directly from a portion of the deck.	LF
SR-RC SR-CS SR-GS	RC Stringer CS Stringer GS Stringer	A structural element loaded perpendicular to its longitudinal axis that transmits loads from the deck to a deck beam	LF
SR-TIM	TIM Stringer	A dimensional wood element, 5 inches or more in width, loaded perpendicular to its longitudinal axis that transmits loads from the deck or joist to the substructure.	LF
JT-TIM	TIM Joist	A dimensional wood element, less than 5 inches in depth, loaded perpendicular to its longitudinal axis that transmits loads from the deck to a stringer	LF
GP-CS GP-WS	CS Gusset Plate WS Gusset Plate	A structural plate element that provides a connection between other structural elements. Constructed with one or more plates that may be bolted, riveted, or welded.	EA
Substructure Elements (SB)			
CO-RC CO-PCC CO-CS CO-GS CO-TIM	RC Column PCC Column CS Column GS Column TIM Column	A vertical prismatic element that transmits loads (vertical, lateral and/or bending) from the deck or superstructure into a substructure element.	LF
BR-CS BR-GS BR-TIM	CS Brace GS Brace TIM Brace	An element, often diagonally oriented, fastened across pile elements to provide lateral stability.	EA
ST-RC	RC Strut	A element that spans horizontally between substructure elements and carries compression or tension forces.	LF
SW-RC	RC Shear Wall	A structural wall element that transmits vertical and in-plane lateral loads from the deck or superstructure into the ground or to other substructure elements. A shear wall generally is located between two deck or superstructure spans and does not function as an earth retaining structure.	LF
PS-RC	RC Pilaster	A rectangular column element projecting from a wall. May be located at the ends of a wall or within the length of the wall.	LF

Table C-1. Structural Component Elements			
Element Code(s)	**Element Descriptor**	**Element Identification**	**Units[1]**
Substructure Elements (SB)			
AB-RC	RC Abutment	A structural wall element that transmits loads from the deck or superstructure into the ground or to other substructure elements. An abutment is generally located at the end of a bridge or walkway and serves as both a retaining wall and supporting element for vertical loads. Wing walls, if present, should be designated as retaining walls.	LF
RW-RC RW-CS	RC Retaining Wall CS Retaining Wall	A structural wall element that functions primarily to retain soil. It may also carry vertical loads from elements above. Retaining walls are located above water level.	LF
PI-PCC PI-PSC PI-CS PI-TIM	PCC Pile PSC Pile CS Pile TIM Pile	An axially loaded, vertical element that transmits loads from the deck, superstructure, or substructure into the ground via end bearing or friction. Piles are fabricated prior to installation and driven into the ground. Piles are considered deep foundation elements.	EA
PB-PCC PB-PSC PB-CS PB-TIM	PCC Battered Pile PSC Battered Pile CS Battered Pile TIM Battered Pile	A type of pile that is driven at an angle, typically between 30 and 60 degrees from vertical. Battered piles provide lateral stiffness to the structure.	EA
DS-RC	RC Drilled Shaft	An axially loaded, prismatic vertical element that transmits loads from the deck, superstructure, or substructure into the ground via end bearing or friction. Drilled shafts are concrete poured into an excavated shaft and often include belled ends. Drilled shafts are considered deep foundation elements. May be cased or uncased with steel.	EA
PF-CS(S) PF-CS(C)	CS Sand-Filled Pile CS Concrete-Filled Pile	A type of pile that consists of a hollow steel pipe driven into the ground and then filled with material. Includes “Raymond Piles”, which are concrete-filled pipes with tapered cross-sections.	EA
BC-RC BC-PSC BC-CS BC-TIM	RC Bent Cap PSC Bent Cap CS Bent Cap TIM Bent Cap	A horizontally-oriented structural element that transmits loads from superstructure elements to column elements below.	LF
PC-RC PC-PSC PC-CS PC-TIM	RC Pile Cap PSC Pile Cap CS Pile Cap TIM Pile Cap	A horizontally-oriented structural element that transmits loads from substructure or superstructure elements above to pile elements below.	LF

Table C-1. Structural Component Elements			
Element Code(s)	**Element Descriptor**	**Element Identification**	**Units**[1]
Substructure Elements (SB)			
FT-RC	RC Footing	A structural element that transmits loads from a column or wall to the ground with a larger cross-section than the element above. Footings are usually considered shallow foundations.	LF
RP-RC RP-TIM	RC Relieving Platform TIM Relieving Platform	A slab that transmits loads from fill above to deep foundations below. Often used to reduce earth pressures on bulkheads from surcharge loads.	SF
CF-CS CF-WS	CS Cofferdam	Single-cell or multi-cell structural elements used as a retaining, watertight structure.	EA
TR-CS TR-GS	CS Tie Rod GS Tie Rod	A tension-only structural element. Includes elements used as bracing and those used as tie backs for retaining walls. Does not include rods used solely for railing.	EA
DM-RC	RC Dead Man	A reinforced concrete element buried in soil on the landside of a retaining wall or bulkhead. Used as anchorage for another element.	EA
Bearing Elements (BR)			
BR-FX BR-FR BR-PF	Fixed Bearing Free Bearing Partially-Fixed Bearing	Bearings are structural elements that interface between superstructure elements and the supporting element below. Bearings may be fixed (no translation allowed), free (translation and/or rotation allowed), or partially fixed (limited translation and/or rotation allowed)	EA
Joint Elements (JN)			
JN-EL JN-AS	Elastomeric Joint Seal Armored Joint with Seal	A interface between structural elements designed to be watertight (typically decks or slabs)	LF
JN-OP JN-AU	Open Expansion Joint Armored Joint without Seal	An interface between structural elements not designed to be watertight (typically decks or slabs). May or may not have a trough below.	LF

Table C-1. Structural Component Elements			
Element Code(s)	**Element Descriptor**	**Element Identification**	**Units[1]**
Bulkhead Elements (BH)			
BW-RC BW-UC BW-CS BW-GS BW-WS BW-TIM	RC Bulkhead Wall UC Bulkhead Wall CS Bulkhead Wall GS Bulkhead Wall WS Bulkhead Wall TIM Bulkhead Wall	A structural wall element that functions primarily as an earth retaining structure. Primarily subject to out-of-plane lateral loads. Bulkheads generally separate earth fill from water.	LF
BP-RC	RC Bulkhead Pile Cap	A horizontally-oriented structural element along the top of a bulkhead wall that stiffens the top of the wall and may transmit loads from substructure or superstructure elements.	LF
BB-RC BB-CS	RC Bulkhead Wale Beam CS Bulkhead Wale Beam	A bulkhead element loaded perpendicular to its longitudinal axis that stiffens a bulkhead and is attached to tie rods or other anchorages.	LF
BT-CS BT-GS	CS Bulkhead Tie Rod GS Bulkhead Tie Rod	A tension-only structural element, used to restrain the top of a bulkhead wall.	EA

Table C-2. Berthing Component Elements			
Element Code(s)	**Element Descriptor**	**Element Identification**	**Units**[2]
Fender System (FN)			
FP-RC FP-PSC FP-CS FP-GS FP-TIM	RC Fender Pile PSC Fender Pile CS Fender Pile GS Fender Pile TIM Fender Pile	A vertical element that absorbs energy through bending of the member. Fender piles are typically driven into the channel bed and braced at their top to form a propped cantilever.	EA
CH-GS	GS Stay Chains	Heavy-duty chains connecting between wharf structure and other fender elements. Chains types include weight chains (to restrain vertical movement), shear chains (to restrain lateral movement), tension chains (to restrain rotation in cantilevers), and keep chains (for lifting or replacing fender elements).	EA
FF-TIM FF-OTH	TIM Facing OTH Facing	Sacrificial elements fastened to the harbor side of the fender system for the purpose of providing low-friction surfaces and protecting both ships and other fender elements from abrasion damage. Facing includes ultra-high molecular-weight (UHMW) panels, plastic rub strips, and timber elements.	EA
FL-CS FL-GS FL-OTH	CS Fender Panel GS Fender Panel OTH Fender Panel	A rectangular element oriented parallel to the fender system that increases the contact area of the fender system against the ship hull.	EA
FA-RB	OTH Rubber Fender Absorption Unit	An energy-absorbing fender element made of rubber. Cylindrical units are hollow and may be installed perpendicular or parallel to the adjacent element. Also includes conical-shaped cellular units or v-shaped "arch" fender units.	EA
FA-FM	OTH Foam Fender Absorption Unit	An energy-absorbing fender element made of foam with a polymer skin. These fenders typically float freely on the surface and are kept in place by chains.	EA
FA-PN	OTH Pneumatic Fender Absorption Unit	An energy-absorbing fender element made with an air-filled hollow chamber. These fenders typically float freely on the surface and are kept in place by chains.	EA
SF-RC SF-CS SF-GS	RC Support Framing CS Support Framing GS Support Framing	Includes wale beams, bracing, struts, chocks, or other structural framing members of a fender system. Secondary members generally add to the stability of the fender system and do not distribute berthing and mooring forces, but are lumped together with the primary-load carrying members for inspection purposes. Framing is quantified in terms of length per bay.	LF

[2] SF = square foot, LF = linear foot, EA = each

Table C-2. Berthing Component Elements			
Element Code(s)	**Element Descriptor**	**Element Identification**	**Units[2]**
Fender System (FN)			
CA-RC CA-TIM CA-OTH	RC Camel TIM Camel OTH Camel	Compression member used to offset a wharf or dolphin from a ship. Camels typically float freely in elevation with the tide.	EA
Mooring Elements (MR)			
BI-MT	MT Bitt	A type of fitting for the purpose of attaching mooring lines from vessels. Bitts are pairs of round metal poles, usually on a single casting.	EA
BD-MT	MT Bollard	A type of fitting for the purpose of attaching mooring lines from vessels. Bollards are a cast steel cylinder with a capped head extending up from a base plate	EA
CL-MT	MT Cleat	A type of fitting for the purpose of attaching mooring lines from vessels. Cleats normally have two horizontally-opposed projecting horns.	EA
DL-RC DL-CS DL-TIM	RC Dolphin Platform CS Dolphin Platform TIM Dolphin Platform	A working surface for personnel located on top of dolphin piles.	SF
DP-RC DP-PSC DP-CS DP-TIM	RC Dolphin Pile PSC Dolphin Pile CS Dolphin Pile TIM Dolphin Pile	A vertical element driven into the channel bed and extending above the free surface of the water. May be installed singly (monopile) or in groups.	EA

Table C-3. Shoreline Component Elements			
Element Code(s)	**Element Descriptor**	**Element Identification**	**Units**[3]
Protected Shoreline (SH)			
RR-OTH	Riprap	Rough stone or concrete pieces of various sizes used to prevent scour, shoreline erosion, or damage induced by waves or water flow. Usually the size of cobbles (2 inch in diameter) or larger.	LF
SB-RC SB-UC	RC Block Walls UC Block Walls	Gravity block walls that rely on their weight for stability and are used to prevent scour, shoreline erosion, or damage induced by waves or water flow. May function as an earth retaining structure.	LF
SG-OTH	Gabion Baskets	Rectangular wire mesh baskets filled with rough stone used to prevent scour, shoreline erosion, or damage induced by waves or water flow.	LF
SV-RC SV-UC SV-TIM	RC Revetment UC Revetment TIM Revetment	Protected slopes used to prevent scour, shoreline erosion, or damage induced by waves or water flow.	LF
SO-OTH	Other	Other types of shoreline stabilization systems not listed elsewhere.	LF
Unprotected Shoreline (SU)			
SU-OTH	Unprotected shoreline	Unprotected or undeveloped shoreline within the boundaries of a terminal or facility.	LF

[3] SF = square foot, LF = linear foot, EA = each

Table C-4. Ancillary Component Elements			
Element Code(s)	**Element Descriptor**	**Element Identification**	**Units[4]**
Crane and Train (CT)			
TR-MT	Train Rails Crane Rails	Track and rail elements attached to deck components of a maritime asset. Does not include mechanical operation such as track switches.	LF
TD-MT	Crane Tie-Downs	Anchorage attached to a structural element for the purpose of providing restraint to a crane	EA
RS-MT	Rail Stops	Elements at the end of a rail line positioned to stop a train or crane from running beyond the designated area	EA
Guards (GU)			
GR-CS GR-TIM GR-OTH	CS Guard Rail TIM Guard Rail OTH Guard Rail	A fence or barrier composed of vertical posts and horizontal rails.	LF
WL-TIM	TIM Wharf Log	Timber logs anchored to a deck for the purpose of preventing vehicles from running off the edge (wheel stop).	LF
Paint and Markings (PM)			
PM-OTH	OTH Paints and Markings	Elements consisting of paint and other markings for regulatory or information purposes (not for corrosion protection).	EA
SP-OTH	OTH Striping	Painted markings on decks or pavement that show traffic flow or load restriction information.	SF
SN-MT	MT Signage	Discrete elements containing regulatory or load-rating information, permanently affixed to a portion of the structure.	EA
Personnel Access Systems (PA)			
LD-CS LD-GS LD-SS	CS Ladder GS Ladder SS Ladder	A vertical element for the purpose of allowing personnel to travel from one level to another. Includes handrails, steps, framing, and attachment.	EA
SA-RC SA-CS SA-GS SA-SS	RC Stair CS Stair GS Stair SS Stair	An element with steps for the purpose of allowing personnel to travel from one level to another. Includes handrails, steps, framing, and attachment.	EA
CK-CS CK-GS CK-SS	CS Catwalk GS Catwalk SS Catwalk	A linear platform intended for walking above another level or water. This element is inclusive of the walking platform, guardrails, and attachments.	LF
MC-MT	MT Manhole Cover	A load-carrying metal cover for a manhole opening.	EA

[4] SF = square foot, LF = linear foot, EA = each

Table C-4. Ancillary Component Elements			
Element Code(s)	**Element Descriptor**	**Element Identification**	**Units[4]**
Personnel Access Systems (PA)			
HC-MT	MT Access Hatch Cover	A load-carrying metal cover over an opening in the deck. Access hatches may not be large enough to allow for personnel entry, but covers are needed to form a continuous deck surface.	EA
Utilities (UT)			
UT-CS UT-GS	CS Supports GS Supports	Regularly-spaced elements such as hangers, brackets, and accessories for the purpose of supporting utility lines. Utility lines may include steam, potable water, fire water, seawater, sanitary sewer, oily waste disposal, fuel, compressed air, electrical, data and communication services, and fire alarm systems.	EA

APPENDIX D - CONDITION STATES (ALPHABETICAL)

Code	Condition Name	Condition Definition	Condition States			
			CS1 (Good)	CS2 (Fair)	CS3 (Poor)	CS4 (Severe)
ABWC	Abrasion/ wear	Abrasion or wear in concrete elements or wearing surfaces (including cementitious and bituminous).	No abrasion or wear.	Coarse aggregate is exposed but remains secure in concrete matrix.	Coarse aggregate has been exposed and is loosened from concrete matrix due to wear.	N/A
ABWT	Abrasion/ wear	Abrasion or wear in timber elements	No abrasion or wear.	Less than 10% of the member thickness is lost due to abrasion/wear.	More than 10% of the member thickness is lost due to abrasion/wear.	N/A
ADHS	Seal adhesion	Loss of adhesion in sealed joints	Seals are fully adhered.	Seals are adhered for more than 50% of joint height.	Seals are adhered for less than 50% of joint height but still retain some adhesion.	Complete loss of adhesion.
ALGN	Alignment	Alignment of elements that are expected to experience translation or rotation (e.g., bearings, joint seals)	Translation and/or rotation is expected for the temperature conditions at the time of inspection.	Translation and/or rotation is not consistent with the temperature conditions at the time of inspection, but all elements appear to be unimpinged.	Translation and/or rotation of elements are causing elements to impinge.	Translation and/or rotation of elements are causing elements to impinge causing global misalignment.
ANCI	General condition of ancillary elements	Distress or damage to ancillary elements, such as ladders, catwalks, wharf logs, train rails and stops, utility lines and hangers, etc.	No visible distress, or corrosion on less than 10 percent of surface.	Corrosion or deterioration of coating on 10 to 50 percent of surface, but no section loss of base material.	Section loss is present or element has major wear marks, but assessment has determined element's functionality or capacity is not compromised.	Section loss is present and distortion or displacement is significant enough to affect element's immediate functionality or capacity
BULG	Bulging/ splitting/ tearing	Bulging/ splitting/ tearing of rubber/ composite materials (including bearing pads, rubber fender units, pneumatic fender units, or camels)	No bulging, splitting, or tearing or other visible distress.	Minor bulging or partial depth distress such as cracking, tears, or gouges.	Moderate bulging. Minor splitting or tearing visible. Element is still functional.	Severe bulging, splitting, or tearing visible. Distress that compromises functionality of element, or element is missing.
CHLK	Chalking	Chalking in metal protective coatings	No chalking.	Surface dulling.	Loss of pigment.	N/A

Code	Condition Name	Condition Definition	Condition States			
			CS1 (Good)	CS2 (Fair)	CS3 (Poor)	CS4 (Severe)
CHSH	Check/ shake	Checks and/or shakes in timber elements, including splits and delamination. Does not include fractures (i.e., load-induced cracks due to flexure or shear)	Checks or shakes penetrate less than 5% of the member thickness, regardless of location on member.	Checks or shakes penetrate 5-50% of member thickness and not in a tension zone OR splits/delamination (including through-checks and through-shakes) have been effectively arrested and do not compromise element's functionality or capacity	Checks or shakes penetrate more than 50% of member thickness or more than 5% of member thickness in a tension zone OR splits/delamination (including through-checks and through-shakes) are present but assessment has determined element's functionality or capacity is not compromised.	Checks, shakes, or splits/ delamination (including through-checks and through-shakes) are significant enough to affect element's immediate functionality or capacity
CONX	Connection	Connection distress in metal and other material elements. Connections include items such as heavy hex structural bolts, post-installed anchors, through-bolts, anchor rods etc.	No connection distress; connection is in place and functioning as intended.	Loose fasteners or minor pack rust without distortion is present, but connection is in place and functioning as intended.	Missing fasteners or broken / cracked welds; pack rust with distortion may be present; visible section loss on fastener of up to 20 percent OR assessment has determined connection's remaining capacity is not compromised.	Missing fasteners, broken/cracked welds, and/or pack rust cause translation and/or rotation preventing the connection from functioning as intended. Section loss on fastener in excess of 20 percent. Distress is significant enough to affect element's capacity.
CORR	Corrosion	Corrosion of metal and other material elements, excluding connections. Corrosion of connections is covered by condition state CONX.	No corrosion observed.	Freckled rust or light pitting present; section loss is not evident.	Section loss is evident or pack rust is present, but assessment has determined element's functionality or capacity is not compromised.	Section loss is significant enough to affect element's immediate functionality or capacity Pack rust is causing element instability or prevents elements from functioning as intended.

Code	Condition Name	Condition Definition	Condition States			
			CS1 (Good)	CS2 (Fair)	CS3 (Poor)	CS4 (Severe)
CRKC	Cracking [See Table Note 1]	Cracking in concrete elements and wearing surfaces (including cementitious and bituminous materials)	Insignificant cracks or moderate-width cracks that have been sealed.	Unsealed moderate-width cracks or unsealed moderate map cracking.	Wide cracks or heavy map cracking. For structural elements, this excludes cracks associated with reduction of structural capacity (e.g., bond splitting cracks, shear, bending, or torsional stress cracks)	Wide cracks associated with reduction of structural capacity or functionality (e.g., i.e., loss of bond, shear, bending, or torsional stress cracks).
CRKM	Cracking	Fatigue cracking in metals and other material elements	No cracking.	Cracks have self-arrested or have been arrested.	Cracks are not arrested.	Cracks are not arrested and may affect load-path redundancy.
DBIM	Debris impaction	Damage to any element by debris impaction	No debris observed or shallow debris present (no hard-packed debris) with no effect on element performance.	Debris present (including hard-packed) with minor or no effect on element performance.	Debris present with moderate effect on element performance.	Debris present with severe effect on element performance.
DECY	Decay/ section loss/ infestation	Decay, section loss, or insect infestation for timber elements	No decay or section loss observed.	Less than 10% of the member thickness is affected due to decay, section loss, or infestation (i.e., marine borers).	Over 10% of the member thickness is affected due to decay, section loss, or infestation (i.e., marine borers), but assessment has determined element's functionality or capacity is not compromised.	Over 10% of the member thickness is affected due to decay, section loss, or infestation (i.e., marine borers) such that element's immediate functionality or capacity is affected
DIST	Distortion	Distortion from original location for any element	No distortion.	Elements have minor distortion, but translation or rotation is within the acceptable limits for the element.	Elements have moderate distortion, but translation or rotation is within the acceptable limits for the element OR a structural review has determined the element's functionality or capacity is not compromised.	Elements have distortion such that element's immediate functionality or capacity is affected. Element may also be missing.

Code	Condition Name	Condition Definition	Condition States			
			CS1 (Good)	CS2 (Fair)	CS3 (Poor)	CS4 (Severe)
DLSP	Delamination/ spall (partial-depth)	Spalls or delamination in concrete elements or wearing surfaces. Distress does not extend through full thickness of element.	No delaminated or spalled areas.	Delaminated. Spall is less than 1 inch in depth or less than 6 inches in diameter. Patched area is sound. Partial depth pothole in wearing surface.	Spall greater than 1 inch in depth or greater than 6 inches in diameter.	Significant spalls or distress to patched areas is significant enough to affect element's immediate functionality or capacity
DLSF	Delamination / spall (full-depth)	Spalls or delamination in concrete elements or wearing surfaces. Distress extends extend through full thickness of element. Includes full depth pothole in wearing surface.	No delaminated or spalled areas.	Distress is less than 6 inches in diameter.	Distress is greater than 6 inches in diameter.	Distress is significant enough to affect element's immediate functionality or capacity
DSPL	Displacement	Displaced protected shoreline elements, including rip-rap or gabion baskets.	No displacement.	Blocks or stones may be slightly out of alignment, but displacement is within the acceptable limits for the element.	Blocks or stones may be shifted significantly out of alignment but displacement is within the acceptable limits for the element OR a structural review has determined the element's functionality or capacity is not compromised.	Blocks or stones out of alignment such that element's immediate functionality or capacity may be affected
EFRS	Efflorescence/ rust staining	Efflorescence/ rust staining in concrete elements	No efflorescence or rust staining.	Surfaces are white or leached without build-up or rust staining.	Heavy buildup of efflorescence and/or rust staining.	N/A
EROS	Erosion	Erosion of shoreline	No change in slope or profile of shoreline due to erosion.	Erosion has changed the slope or profile of the shoreline but is not impacting usage of the water.	Erosion, if left unchecked, can lead to conditions that impact usage of the waterway or other near-shore assets.	Erosion is impacting the usage of the waterway (i.e., erosion has undermined a tree and left it vulnerable to falling in navigable waters).

Code	Condition Name	Condition Definition	Condition States			
			CS1 (Good)	CS2 (Fair)	CS3 (Poor)	CS4 (Severe)
EXPR	Exposed reinforcement	Exposed conventional reinforcement in concrete elements. Excludes prestressing strands.	No exposed reinforcement.	Exposed reinforcement without measurable section loss.	Exposed reinforcement with measurable section loss, but assessment has determined element's functionality or capacity is not compromised.	Exposed reinforcement with section loss that is significant enough to affect element's immediate functionality or capacity
EXPS	Exposed prestressing	Exposed prestressing steel in concrete elements	No exposed prestressing steel or tendon.	Exposed prestressing without visible corrosion.	Exposed prestressing with visible corrosion, but assessment has determined element's functionality or capacity is not compromised.	Exposed prestressing with section loss that is significant enough to affect element's immediate functionality or capacity
GALV	Galvanized zinc coating	Condition of galvanized zinc patina on steel elements.	No white or red corrosion products. Surface may be bright and shiny, spangled, or matte gray.	White rust (zinc oxide) is visible on surface.	Red rust is visible through coating on less than 5 percent of the local area.	Red rust exceeds 5 percent of the local area.
FNFA	Condition of fender facing	Distress or damage to fender facing	No visible distress.	Partial-depth distress, such as gouges, spalls, or tears (e.g. surficial damage to timbers; cracks in HDPE pads).	Full-thickness distress but facing still provides protection between fender panel or framing and vessel hull (e.g. full-depth gouge in HDPE pad, but remainder of pad is intact and providing protection).	Distress that compromises functionality of element, or element is missing (e.g., fractured timbers, missing panels). Also applies if fasteners are exposed to vessel hulls as a result of missing or damaged facing.
FNPN	Condition of fender panel	Distress or damage to fender panels.	No visible distress	Corrosion staining of fender panel.	Distortion of fender panel or section loss is present but assessment has determined element's functionality or capacity is not compromised. (maximum of 50 percent in thickness at any point)	Distortion of fender panel that could gouge vessel hull, or is otherwise significant enough to affect element's immediate functionality or capacity

Code	Condition Name	Condition Definition	Condition States			
			CS1 (Good)	CS2 (Fair)	CS3 (Poor)	CS4 (Severe)
FNSC	Condition of fender stay chain	Distress or damage to stay chains	No visible distress.	Corrosion of stay chain but less than 10 percent section loss.	Section loss up to 50 percent but assessment has determined element's functionality or capacity is not compromised	Section loss is significant enough to affect element's immediate functionality or capacity
FRCT	Fracture	Load-induced fractures in timber elements (i.e., flexural or shear cracks)	No cracks observed.	Cracks have been effectively arrested and do not compromise element's functionality or capacity	Cracks are not arrested but assessment has determined element's functionality or capacity is not compromised	Cracks are not arrested and are significant enough to affect element's immediate functionality or capacity
FRPW	Fiber-reinforced polymer wrap	Condition of fiber-reinforced (Glass, Carbon, or other material) polymer permanently bonded to a member. Also may apply to unbonded plastic wrap, such as for timber piles.	No visible distress.	Minor bubbles or blisters. Minor abrasion to surface layer.	Delamination, gouges, holes, tears, or splits in material but assessment has determined capacity or functionality of wrap is not compromised.	Delamination, gouges, holes, tears, or splits in material that affects capacity or functionality of wrap.
LEAK	Leakage	Leakage through or around any joints	No leakage.	Minor leakage; minor dripping through joint.	Moderate leakage; more than a drip and less than free flow of water.	Freely flowing water through joint.
LSBR	Loss of bearing area	Loss of bearing area for any element	No loss of bearing area.	Less than 10% loss of bearing area.	More than 10% of bearing area lost but assessment has determined element's functionality or capacity is not compromised.	More than 10% of bearing area lost and is significant enough to affect element's immediate functionality or capacity
MISS	Missing	Element intended to be in place is missing. Does not apply to elements that have been intentionally removed as part of a modification.	N/A	N/A	Element is missing but assessment has determined element is not needed for functionality or capacity.	Element is missing.

Code	Condition Name	Condition Definition	Condition States			
			CS1 (Good)	CS2 (Fair)	CS3 (Poor)	CS4 (Severe)
MRFT	Condition of mooring fitting	Distress or damage to cleats, bollards, or bitts	No visible distress, or corrosion on less than 10 percent of surface.	Corrosion or deterioration of coating on 10 to 50 percent of surface, but no section loss of base material.	Section loss is present or element has major wear marks, but assessment has determined element's functionality or capacity is not compromised.	Section loss is present and distortion or displacement is significant enough to affect element's immediate functionality or capacity
PEEL	Peeling/ bubbling/ cracking	Peeling, bubbling, or cracking in protective coatings	No peeling, bubbling, or cracking.	Finish coat exhibits peeling, bubbling, or cracking.	Finish and primer coats exhibit peeling, bubbling, or cracking.	Substrate is exposed.
PMAR	Condition of paint and markings	Readability or visibility of marking	Marking is clear and legible.	Marking is faded or illegible on 10 to 25 percent of surface.	Marking is faded or illegible on 25 to 50 percent of surface.	Marking is missing, faded or illegible on more than 50 percent of surface.
PTCH	Patched area	Patched areas in concrete or wearing surfaces. In concrete, limited to partial-depth repairs. Full-depth repairs are considered equivalent to an original element	Sound patched areas.	Patched area is unsound or showing distress.	Patched area is unsound and some or all of the patch has spalled. Corrosion staining is observed in patch. Does not compromise element's functionality or capacity. '	Unsound patched areas are significant enough to affect element's immediate functionality or capacity
SCOR	Scour	Scour of substructure elements	No scour observable.	Scour exists within tolerable limits or has been arrested with effective countermeasures.	Scour exceeds tolerable limits but is less than the critical limits determined by scour evaluation OR assessment has determined element's functionality or capacity is not compromised.	Scour exceeds critical limits determined by scour evaluation and is significant enough to affect element's immediate functionality or capacity
STTL	Settlement	Settlement in substructure elements	No settlement.	Settlement exists within tolerable limits or has been arrested with effective countermeasures. No observed element distress.	Settlement exceeds tolerable limits but is less than the critical limits determined by evaluation OR assessment has determined element's functionality or capacity is not compromised.	Settlement exceeds critical limits or is significant enough to affect element's immediate functionality or capacity

Code	Condition Name	Condition Definition	Condition States			
			CS1 (Good)	CS2 (Fair)	CS3 (Poor)	CS4 (Severe)
TRAL	Track Joint Mismatch or Distortion. [See Table Note 2]	Mis-alignment of rails at track joints of either tread (top surface) or gage (inner surface) at ends of rails, or distortion of rails.	No misalignment	Misalignment or distortion less than 1/4 inch.	Misalignment or distortion greater than 1/4 inch where assessment has determined element's functionality is not compromised.	Misalignment or distortion greater than 1/4 inch that affects element's functionality.
TRFS	Track Fissure, Fracture, or Split. [See Table Note 2]	Transverse or compound fissure or fracture in rail track, head or web splitting, or other rail defect.	No defect	For transverse defects: affects less than 5 percent of rail-head cross section. For longitudinal defects: defect is less than 1 inch in length.	For transverse defects: defect affects more than 5 percent of rail-head cross section. For longitudinal defects: defect is greater than 1 inch in length. Defect has been strengthened or assessment has determined functionality is not compromised.	For transverse defects: affects more than 5 percent of rail-head cross section. For longitudinal defects: defect is greater than 1 inch in length.
TRSF	Track Surface Condition [See Table Note 2]	Rail head surface damage, flattening, or corrosion	No defect	Minor pitting, flattening, or other surface defects.	Section loss of rail; surface flattening of up to 3/8 inch deep and up to 8 inches long.	Surface defects greater than 3/8 inch in depth and more than 8 inches in length.
WEAR	Wear	Wear of protective coating. Includes wear from abrasion or weathering.	No wear.	Substrate not exposed, coating showing wear or abrasion.	Substrate is partially exposed; thickness of the coating is reduced.	Substrate exposed; protective coating is no longer effective.
WETH	Weathering Steel Patina [See Table Note 3]	Condition of weathering steel patina (oxide film).	Uniform color pattern, dark brown with some lighter reddish- or purple-brown spots. Patina is adhered.	Dark brown but with minor color variation. Small loose flakes on surface but underlying patina is adhered.	Dark brown with black blotches, non-uniform texture. Medium (up to 1 inch) sized flakes.	Dark brown, black patina with widespread blotchiness. Laminar sheets or large flakes. Patina is no longer effective.
VOID	Void	Void or other consolidation defects in original concrete construction. Includes honeycombing.	No voids or honeycombing.	Minor honeycombing or bugholes. Shallow partial-depth voids.	Partial-depth or full-depth voids or major honeycombing, but assessment has determined element's functionality or capacity is not affected.	Partial-depth voids or major honeycombing that affects element's functionality or capacity.

Table Notes

1. The selected condition state for concrete cracks should reflect the generalized distress and importance of the cracking. The inspector should consider width, spacing, location, orientation, exposure, and structural implications (i.e. shear crack vs flexural crack). It is not expected that inspectors measure every crack; however, general guidelines for prestressed and conventionally-reinforced concrete are as follows:

Significance / Corresponding Condition State	**Crack Width 'x' (in.)**	
	Prestressed	**Conventionally-Reinforced**
Insignificant (CS1)	$x < 0.004$	$x < 0.012$
Moderate (CS2)	$0.004 < x < 0.009$	$0.012 < x < 0.050$
Wide (CS3 or CS4)	$x > 0.009$	$x > 0.050$

2. Track defect conditions adapted from *Track and Rail and Infrastructure Integrity Compliance Manual: Volume II - Chapter 1 - Track Safety Standards - Classes 1 through 5*, published by Federal Railroad Administration, Jan 2014. Accessible at: https://www.fra.dot.gov/Elib/Details/L04404

3. Weathering steel descriptions from Crampton, D.D., Holloway, K.P. and Fraczek, J., *Assessment of Weathering Steel Bridge Performance in Iowa and Development of Inspection and Maintenance Techniques*, Final Report SPR 90-00-RB17-012, February 21, 2013. Accessible at http://publications.iowa.gov/14956/1/Iowa_Weathering_Steel_Final_Report_2-21-2013.pdf.

APPENDIX E - CONDITION STATES (BY MATERIAL)

List of Condition States by Component and Material Type

Structural Components

Concrete Materials

Code	Condition Name
ABWC	Abrasion/ wear
CRKC	Cracking
DIST	Distortion
DLSP	Delamination/ spall (partial-depth)
DLSF	Delamination / spall (full-depth)
EFRS	Efflorescence/ rust staining
EXPR	Exposed reinforcement
EXPS	Exposed prestressing
LSBR	Loss of bearing area
MISS	Missing
PTCH	Patched area
SCOR	Scour
STTL	Settlement
VOID	Voids or Honeycombing

Steel / Metal Materials

Code	Condition Name
CONX	Connection distress
CORR	Corrosion
CRKM	Cracking
DIST	Distortion
LSBR	Loss of bearing area
MISS	Missing
SCOR	Scour
STTL	Settlement

Timber Materials

Code	Condition Name
ABWT	Abrasion/ wear
CHSH	Check/ shake
CONX	Connection distress
DECY	Decay/ section loss/ infestation
DIST	Distortion
FRCT	Fracture
LSBR	Loss of bearing area
MISS	Missing
SCOR	Scour
STTL	Settlement

Joints and Bearings

Code	Condition Name
ADHS	Seal adhesion
ALGN	Alignment
BULG	Bulging/ splitting/ tearing
CORR	Corrosion
DBIM	Debris impaction
DIST	Distortion
LEAK	Leakage

Berthing & Mooring System Components*

Fender Systems

Code	Condition Name
BULG	Bulging/ splitting/ tearing
DBIM	Debris impaction
DIST	Distortion
FNFA	Condition of fender facing
FNPN	Condition of fender panel
FNSC	Condition of fender stay chain
MISS	Missing
SCOR	Scour
STTL	Settlement

Mooring Fittings

Code	Condition Name
DIST	Distortion
MISS	Missing
MRFT	Condition of mooring fitting

**For dolphins and "stick-built" fender systems, refer to structural component materials*

Shoreline Components

Protected and Unprotected Shorelines

Code	Condition Name
DBIM	Debris impaction
DSPL	Displacement
EROS	Erosion
SCOR	Scour

Ancillary Components

Ancillary Elements

Code	Condition Name
ANCI	General condition of ancillary elements
CONX	Connection distress
CRKM	Cracking
DBIM	Debris impaction
PMAR	Condition of paint and markings
TRAL	Track Joint Mismatch or Distortion.
TRFS	Track Fissure, Fracture, or Split.
TRSF	Track Surface Condition

Coatings or Wraps (as applicable to element)

Protective Coatings

Code	Condition Name
CHLK	Chalking
GALV	Galvanized Zinc Coating
FRPW	Fiber-reinforced polymer / plastic wraps
PEEL	Peeling/ bubbling/ cracking
WEAR	Wear
WETH	Weathering Steel Patina

Type	Code	Condition Name	Condition Definition	Condition States			
				CS1 (Good)	CS2 (Fair)	CS3 (Poor)	CS4 (Severe)
Concrete	ABWC	Abrasion/ wear	Abrasion or wear in concrete elements.	No abrasion or wear.	Coarse aggregate is exposed but remains secure in concrete matrix.	Coarse aggregate has been exposed and is loosened from concrete matrix due to wear.	N/A
	CRKC	Cracking [See Table Note 1]	Cracking in concrete elements (including wearing surfaces)	Insignificant cracks or moderate-width cracks that have been sealed.	Unsealed moderate-width cracks or unsealed moderate map cracking.	Wide cracks or heavy map cracking. For structural elements, this excludes cracks associated with reduction of structural capacity (e.g., bond splitting cracks, shear, bending, or torsional stress cracks)	Wide cracks associated with reduction of structural capacity or functionality (e.g., loss of bond, shear, bending, or torsional stress cracks).
	DIST	Distortion	Distortion from original location for any element	No distortion.	Elements have minor distortion, but translation or rotation is within the acceptable limits for the element.	Elements have moderate distortion, but translation or rotation is within the acceptable limits for the element OR a structural review has determined the element's functionality or capacity is not compromised.	Elements have distortion such that element's immediate functionality or capacity is affected. Element may also be missing.
	DLSP	Delamination/ spall (partial-depth)	Spalls or delamination in concrete elements or wearing surfaces. Distress does not extend through full thickness of element.	No delaminated or spalled areas.	Delaminated. Spall is less than 1 inch in depth or less than 6 inches in diameter. Patched area is sound. Partial depth pothole in wearing surface.	Spall greater than 1 inch in depth or greater than 6 inches in diameter.	Significant spalls or distress to patched areas is significant enough to affect element's immediate functionality or capacity

Type	Code	Condition Name	Condition Definition	Condition States			
				CS1 (Good)	CS2 (Fair)	CS3 (Poor)	CS4 (Severe)
Concrete	DLSF	Delamination / spall (full-depth)	Spalls or delamination in concrete elements or wearing surfaces. Distress extends extend through full thickness of element. Includes full depth pothole in wearing surface.	No delaminated or spalled areas.	Distress is less than 6 inches in diameter.	Distress is greater than 6 inches in diameter.	Distress is significant enough to affect element's immediate functionality or capacity
	EFRS	Efflorescence/ rust staining	Efflorescence/ rust staining in concrete elements	No efflorescence or rust staining.	Surfaces are white or leached without build-up or rust staining.	Heavy buildup of efflorescence and/or rust staining.	N/A
	EXPR	Exposed reinforcement	Exposed conventional reinforcement in concrete elements. Excludes prestressing strands.	No exposed reinforcement.	Exposed reinforcement without measurable section loss.	Exposed reinforcement with measurable section loss, but assessment has determined element's functionality or capacity is not compromised.	Exposed reinforcement with section loss that is significant enough to affect element's immediate functionality or capacity
	EXPS	Exposed prestressing	Exposed prestressing steel in concrete elements	No exposed prestressing steel or tendon.	Exposed prestressing without visible corrosion.	Exposed prestressing with visible corrosion, but assessment has determined element's functionality or capacity is not compromised.	Exposed prestressing with section loss that is significant enough to affect element's immediate functionality or capacity
	LSBR	Loss of bearing area	Loss of bearing area for concrete element	No loss of bearing area.	Less than 10% loss of bearing area.	More than 10% of bearing area lost but assessment has determined element's functionality or capacity is not compromised.	More than 10% of bearing area lost and is significant enough to affect element's immediate functionality or capacity
	MISS	Missing	Element intended to be in place is missing. Does not apply to elements that have been intentionally removed as part of a modification.	N/A	N/A	Element is missing but assessment has determined element is not needed for functionality or capacity.	Element is missing.

Type	Code	Condition Name	Condition Definition	Condition States			
				CS1 (Good)	CS2 (Fair)	CS3 (Poor)	CS4 (Severe)
Concrete	PTCH	Patched area	Patched areas in concrete. In concrete, limited to partial-depth repairs. Full-depth repairs are considered equivalent to an original element	Sound patched areas.	Patched area is unsound or showing distress.	Patched area is unsound and some or all of the patch has spalled. Corrosion staining is observed in patch. Does not compromise element's functionality or capacity. '	Unsound patched areas are significant enough to affect element's immediate functionality or capacity
	SCOR	Scour	Scour of substructure elements	No scour observable.	Scour exists within tolerable limits or has been arrested with effective countermeasures.	Scour exceeds tolerable limits but is less than the critical limits determined by scour evaluation OR assessment has determined element's functionality or capacity is not compromised.	Scour exceeds critical limits determined by scour evaluation and is significant enough to affect element's immediate functionality or capacity
	STTL	Settlement	Settlement in substructure elements	No settlement.	Settlement exists within tolerable limits or has been arrested with effective countermeasures. No observed element distress.	Settlement exceeds tolerable limits but is less than the critical limits determined by evaluation OR assessment has determined element's functionality or capacity is not compromised.	Settlement exceeds critical limits or is significant enough to affect element's immediate functionality or capacity
	VOID	Void	Void or other consolidation defects in original concrete construction. Includes honeycombing.	No voids or honeycombing.	Minor honeycombing or bugholes. Shallow partial-depth voids.	Partial-depth or full-depth voids or major honeycombing, but assessment has determined element's functionality or capacity is not affected.	Partial-depth voids or major honeycombing that affects element's functionality or capacity.

Type	Code	Condition Name	Condition Definition	Condition States			
				CS1 (Good)	CS2 (Fair)	CS3 (Poor)	CS4 (Severe)
Steel/Metals	CONX	Connection	Connection distress in metal and other material elements. Connections include items such as heavy hex structural bolts, post-installed anchors, through-bolts, anchor rods etc.	No connection distress; connection is in place and functioning as intended.	Loose fasteners or minor pack rust without distortion is present, but connection is in place and functioning as intended.	Missing fasteners or broken / cracked welds; pack rust with distortion may be present; visible section loss on fastener of up to 20 percent OR assessment has determined connection's remaining capacity is not compromised.	Missing fasteners, broken/cracked welds, and/or pack rust cause translation and/or rotation preventing the connection from functioning as intended. Section loss on fastener in excess of 20 percent. Distress is significant enough to affect element's capacity.
	CORR	Corrosion	Corrosion of metal and other material elements, excluding connections. Corrosion of connections is covered by condition state CONX.	No corrosion observed.	Freckled rust or light pitting present; section loss is not evident.	Section loss is evident or pack rust is present, but assessment has determined element's functionality or capacity is not compromised.	Section loss is significant enough to affect element's immediate functionality or capacity Pack rust is causing element instability or prevents elements from functioning as intended.
	CRKM	Cracking	Fatigue cracking in metals and other material elements	No cracking.	Cracks have self-arrested or have been arrested.	Cracks are not arrested.	Cracks are not arrested and may affect load-path redundancy.
	DIST	Distortion	Distortion from original location for any element	No distortion.	Elements have minor distortion, but translation or rotation is within the acceptable limits for the element.	Elements have moderate distortion, but translation or rotation is within the acceptable limits for the element OR a structural review has determined the element's functionality or capacity is not compromised.	Elements have distortion such that element's immediate functionality or capacity is affected. Element may also be missing.

Type	Code	Condition Name	Condition Definition	Condition States			
				CS1 (Good)	CS2 (Fair)	CS3 (Poor)	CS4 (Severe)
Steel/Metals	LSBR	Loss of bearing area	Loss of bearing area for any elements	No loss of bearing area.	Less than 10% loss of bearing area.	More than 10% of bearing area lost but assessment has determined element's functionality or capacity is not compromised.	More than 10% of bearing area lost and is significant enough to affect element's immediate functionality or capacity
	MISS	Missing	Element intended to be in place is missing. Does not apply to elements that have been intentionally removed as part of a modification.	N/A	N/A	Element is missing but assessment has determined element is not needed for functionality or capacity.	Element is missing.
	SCOR	Scour	Scour of substructure elements	No scour observable.	Scour exists within tolerable limits or has been arrested with effective countermeasures.	Scour exceeds tolerable limits but is less than the critical limits determined by scour evaluation OR assessment has determined element's functionality or capacity is not compromised.	Scour exceeds critical limits determined by scour evaluation and is significant enough to affect element's immediate functionality or capacity
	STTL	Settlement	Settlement in substructure elements	No settlement.	Settlement exists within tolerable limits or has been arrested with effective countermeasures. No observed element distress.	Settlement exceeds tolerable limits but is less than the critical limits determined by evaluation OR assessment has determined element's functionality or capacity is not compromised.	Settlement exceeds critical limits or is significant enough to affect element's immediate functionality or capacity

Type	Code	Condition Name	Condition Definition	Condition States			
				CS1 (Good)	CS2 (Fair)	CS3 (Poor)	CS4 (Severe)
Timber	ABWT	Abrasion/ wear	Abrasion or wear in timber elements	No abrasion or wear.	Less than 10% of the member thickness is lost due to abrasion/wear.	More than 10% of the member thickness is lost due to abrasion/wear.	N/A
	CHSH	Check/ shake	Checks and/or shakes in timber elements, including splits and delamination. Does not include fractures (i.e., load-induced cracks due to flexure or shear).	Checks or shakes penetrate less than 5% of the member thickness, regardless of location on member.	Checks or shakes penetrate 5-50% of member thickness and not in a tension zone OR splits/delamination (including through-checks and through-shakes) have been effectively arrested and do not compromise element's functionality or capacity	Checks or shakes penetrate more than 50% of member thickness or more than 5% of member thickness in a tension zone OR splits/delamination (including through-checks and through-shakes) are present but assessment has determined element's functionality or capacity is not compromised.	Checks, shakes, or splits/ delamination (including through-checks and through-shakes) are significant enough to affect element's immediate functionality or capacity
	CONX	Connection	Connection distress in metal and other material elements. Connections include items such as heavy hex structural bolts, post-installed anchors, through-bolts, anchor rods etc.	No connection distress; connection is in place and functioning as intended.	Loose fasteners or minor pack rust without distortion is present, but connection is in place and functioning as intended.	Missing fasteners or broken / cracked welds; pack rust with distortion may be present; visible section loss on fastener of up to 20 percent OR assessment has determined connection's remaining capacity is not compromised.	Missing fasteners, broken/cracked welds, and/or pack rust cause translation and/or rotation preventing the connection from functioning as intended. Section loss on fastener in excess of 20 percent. Distress is significant enough to affect element's capacity.

Type	Code	Condition Name	Condition Definition	Condition States			
				CS1 (Good)	CS2 (Fair)	CS3 (Poor)	CS4 (Severe)
Timber	DECY	Decay/ section loss/ infestation	Decay, section loss, or insect infestation for timber elements.	No decay or section loss observed.	Less than 10% of the member thickness is affected due to decay, section loss, or infestation (i.e., marine borers).	Over 10% of the member thickness is affected due to decay, section loss, or infestation (i.e., marine borers), but assessment has determined element's functionality or capacity is not compromised.	Over 10% of the member thickness is affected due to decay, section loss, or infestation (i.e., marine borers) such that element's immediate functionality or capacity is affected
	DIST	Distortion	Distortion from original location for any element	No distortion.	Elements have minor distortion, but translation or rotation is within the acceptable limits for the element.	Elements have moderate distortion, but translation or rotation is within the acceptable limits for the element OR a structural review has determined the element's functionality or capacity is not compromised.	Elements have distortion such that element's immediate functionality or capacity is affected. Element may also be missing.
	FRCT	Fracture	Load-induced fractures in timber elements (i.e., flexural or shear cracks).	No cracks observed.	Cracks have been effectively arrested and do not compromise element's functionality or capacity	Cracks are not arrested but assessment has determined element's functionality or capacity is not compromised	Cracks are not arrested and are significant enough to affect element's immediate functionality or capacity
	LSBR	Loss of bearing area	Loss of bearing area for any elements	No loss of bearing area.	Less than 10% loss of bearing area.	More than 10% of bearing area lost but assessment has determined element's functionality or capacity is not compromised.	More than 10% of bearing area lost and is significant enough to affect element's immediate functionality or capacity

Type	Code	Condition Name	Condition Definition	Condition States			
				CS1 (Good)	CS2 (Fair)	CS3 (Poor)	CS4 (Severe)
Timber	MISS	Missing	Element intended to be in place is missing. Does not apply to elements that have been intentionally removed as part of a modification.	N/A	N/A	Element is missing but assessment has determined element is not needed for functionality or capacity.	Element is missing.
	SCOR	Scour	Scour of substructure elements	No scour observable.	Scour exists within tolerable limits or has been arrested with effective countermeasures.	Scour exceeds tolerable limits but is less than the critical limits determined by scour evaluation OR assessment has determined element's functionality or capacity is not compromised.	Scour exceeds critical limits determined by scour evaluation and is significant enough to affect element's immediate functionality or capacity
	STTL	Settlement	Settlement in substructure elements	No settlement.	Settlement exists within tolerable limits or has been arrested with effective countermeasures. No observed element distress.	Settlement exceeds tolerable limits but is less than the critical limits determined by evaluation OR assessment has determined element's functionality or capacity is not compromised.	Settlement exceeds critical limits or is significant enough to affect element's immediate functionality or capacity

Type	Code	Condition Name	Condition Definition	Condition States			
				CS1 (Good)	CS2 (Fair)	CS3 (Poor)	CS4 (Severe)
Joints and Bearings	ADHS	Seal adhesion	Loss of adhesion in sealed joints	Seals are fully adhered.	Seals are adhered for more than 50% of joint height.	Seals are adhered for less than 50% of joint height but still retain some adhesion.	Complete loss of adhesion.
	ALGN	Alignment	Alignment of elements that are expected to experience translation or rotation (e.g., bearings, joint seals)	Translation and/or rotation is expected for the temperature conditions at the time of inspection.	Translation and/or rotation is not consistent with the temperature conditions at the time of inspection, but all elements appear to be unimpinged.	Translation and/or rotation of elements are causing elements to impinge.	Translation and/or rotation of elements are causing elements to impinge causing global misalignment.
	BULG	Bulging/ splitting/ tearing	Bulging/ splitting/ tearing of rubber/ composite materials (including bearing pads, rubber fender units, pneumatic fender units, or camels)	No bulging, splitting, or tearing or other visible distress.	Minor bulging or partial depth distress such as cracking, tears, or gouges.	Moderate bulging. Minor splitting or tearing visible. Element is still functional.	Severe bulging, splitting, or tearing visible. Distress that compromises functionality of element, or element is missing.
	CORR	Corrosion	Corrosion of metal and other material elements, excluding connections. Corrosion of connections is covered by condition state CONX.	No corrosion observed.	Freckled rust or light pitting present; section loss is not evident.	Section loss is evident or pack rust is present, but assessment has determined element's functionality or capacity is not compromised.	Section loss is significant enough to affect element's immediate functionality or capacity Pack rust is causing element instability or prevents elements from functioning as intended.
	DBIM	Debris impaction	Damage to any element by debris impaction	No debris observed or shallow debris present (no hard-packed debris) with no effect on element performance.	Debris present (including hard-packed) with minor or no effect on element performance.	Debris present with moderate effect on element performance.	Debris present with severe effect on element performance.

Type	Code	Condition Name	Condition Definition	Condition States			
				CS1 (Good)	CS2 (Fair)	CS3 (Poor)	CS4 (Severe)
Joints and Bearings	DIST	Distortion	Distortion from original location for any element	No distortion.	Elements have minor distortion, but translation or rotation is within the acceptable limits for the element.	Elements have moderate distortion, but translation or rotation is within the acceptable limits for the element OR a structural review has determined the element's functionality or capacity is not compromised.	Elements have distortion such that element's immediate functionality or capacity is affected. Element may also be missing.
	LEAK	Leakage	Leakage through or around any joints	No leakage.	Minor leakage; minor dripping through joint.	Moderate leakage; more than a drip and less than free flow of water.	Freely flowing water through joint.

Type	Code	Condition Name	Condition Definition	Condition States			
				CS1 (Good)	CS2 (Fair)	CS3 (Poor)	CS4 (Severe)
Fender Systems	BULG	Bulging/ splitting/ tearing	Bulging/ splitting/ tearing of rubber/ composite materials (including bearing pads, rubber fender units, pneumatic fender units, or camels)	No bulging, splitting, or tearing or other visible distress.	Minor bulging or partial depth distress such as cracking, tears, or gouges.	Moderate bulging. Minor splitting or tearing visible. Bearing's surfaces are not parallel. Element is still functional.	Severe bulging, splitting, or tearing visible. Distress that compromises functionality of element, or element is missing.
	DBIM	Debris impaction	Damage to any element by debris impaction	No debris observed or shallow debris present (no hard-packed debris) with no effect on element performance.	Debris present (including hard-packed) with minor or no effect on element performance.	Debris present with moderate effect on element performance.	Debris present with severe effect on element performance.
	DIST	Distortion	Distortion from original location for any element	No distortion.	Elements have minor distortion, but translation or rotation is within the acceptable limits for the element.	Elements have moderate distortion, but translation or rotation is within the acceptable limits for the element OR a structural review has determined the element's functionality or capacity is not compromised.	Elements have distortion such that element's immediate functionality or capacity is affected
	FNFA	Condition of fender facing	Distress or damage to fender facing.	No visible distress.	Partial-depth distress, such as gouges, spalls, or tears (e.g. surficial damage to timbers; cracks in HDPE pads)	Full-thickness distress but facing still provides protection between fender panel or framing and vessel hull (e.g. full-depth gouge in HDPE pad, but remainder of pad is intact and providing protection).	Distress that compromises functionality of element, or element is missing (e.g., fractured timbers, missing panels). Also applies if fasteners are exposed to vessel hulls as a result of missing or damaged facing.

Type	Code	Condition Name	Condition Definition	Condition States			
				CS1 (Good)	CS2 (Fair)	CS3 (Poor)	CS4 (Severe)
Fender Systems	FNPN	Condition of fender panel	Distress or damage to fender panels.	No visible distress	Corrosion staining of fender panel.	Distortion of fender panel or section loss is present but assessment has determined element's functionality or capacity is not compromised. (maximum of 50 percent in thickness at any point)	Distortion of fender panel that could gouge vessel hull, or is otherwise significant enough to affect element's immediate functionality or capacity
	FNSC	Condition of fender stay chain	Distress or damage to stay chains.	No visible distress.	Corrosion of stay chain but less than 10 percent section loss	Section loss up to 50 percent but assessment has determined element's functionality or capacity is not compromised	Section loss is significant enough to affect element's immediate functionality or capacity
	MISS	Missing	Element intended to be in place is missing. Does not apply to elements that have been intentionally removed as part of a modification.	N/A	N/A	Element is missing but assessment has determined element is not needed for functionality or capacity.	Element is missing.
	SCOR	Scour	Scour of substructure elements	No scour observable.	Scour exists within tolerable limits or has been arrested with effective countermeasures.	Scour exceeds tolerable limits but is less than the critical limits determined by scour evaluation OR assessment has determined element's functionality or capacity is not compromised.	Scour exceeds critical limits determined by scour evaluation and is significant enough to affect element's immediate functionality or capacity

Type	Code	Condition Name	Condition Definition	Condition States			
				CS1 (Good)	CS2 (Fair)	CS3 (Poor)	CS4 (Severe)
Fender Systems	STTL	Settlement	Settlement in substructure elements.	No settlement.	Settlement exists within tolerable limits or has been arrested with effective countermeasures. No observed element distress.	Settlement exceeds tolerable limits but is less than the critical limits determined by evaluation OR assessment has determined element's functionality or capacity is not compromised.	Settlement exceeds critical limits or is significant enough to affect element's immediate functionality or capacity

Type	Code	Condition Name	Condition Definition	Condition States			
				CS1 (Good)	CS2 (Fair)	CS3 (Poor)	CS4 (Severe)
Mooring Fittings	DIST	Distortion	Distortion from original location for any element	No distortion.	Elements have minor distortion, but translation or rotation is within the acceptable limits for the element.	Elements have moderate distortion, but translation or rotation is within the acceptable limits for the element OR a structural review has determined the element's functionality or capacity is not compromised.	Elements have distortion such that element's immediate functionality or capacity is affected. Element may also be missing.
	MISS	Missing	Element intended to be in place is missing. Does not apply to elements that have been intentionally removed as part of a modification.	N/A	N/A	Element is missing but assessment has determined element is not needed for functionality or capacity.	Element is missing.
	MRFT	Condition of mooring fitting	Distress or damage to cleats, bollards, or bitts.	No visible distress, or corrosion on less than 10 percent of surface.	Corrosion or deterioration of coating on 10 to 50 percent of surface, but no section loss of base material.	Section loss is present or element has major wear marks, but assessment has determined element's functionality or capacity is not compromised.	Section loss is present and distortion or displacement is significant enough to affect element's immediate functionality or capacity

Type	Code	Condition Name	Condition Definition	Condition States			
				CS1 (Good)	CS2 (Fair)	CS3 (Poor)	CS4 (Severe)
Shoreline	DBIM	Debris impaction	Damage to any element by debris impaction	No debris observed or shallow debris present (no hard-packed debris) with no effect on element performance.	Debris present (including hard-packed) with minor or no effect on element performance.	Debris present with moderate effect on element performance.	Debris present with severe effect on element performance.
	DSPL	Displacement	Displaced protected shoreline elements, including rip-rap or gabion baskets.	No displacement.	Blocks or stones may be slightly out of alignment, but displacement is within the acceptable limits for the element.	Blocks or stones may be shifted significantly out of alignment but displacement is within the acceptable limits for the element OR a structural review has determined the element's functionality or capacity is not compromised.	Blocks or stones out of alignment such that element's immediate functionality or capacity may be affected
	EROS	Erosion	Erosion of shoreline	No change in slope or profile of shoreline due to erosion.	Erosion has changed the slope or profile of the shoreline but is not impacting usage of the water.	Erosion, if left unchecked, can lead to conditions that impact usage of the waterway or other near-shore assets.	Erosion is impacting the usage of the waterway (i.e., erosion has undermined a tree and left it vulnerable to falling in navigable waters).
	SCOR	Scour	Scour of substructure elements	No scour observable.	Scour exists within tolerable limits or has been arrested with effective countermeasures.	Scour exceeds tolerable limits but is less than the critical limits determined by scour evaluation OR assessment has determined element's functionality or capacity is not compromised.	Scour exceeds critical limits determined by scour evaluation and is significant enough to affect element's immediate functionality or capacity

Type	Code	Condition Name	Condition Definition	Condition States			
				CS1 (Good)	CS2 (Fair)	CS3 (Poor)	CS4 (Severe)
Ancillary	ANCI	General condition of ancillary elements	Distress or damage to ancillary elements, such as ladders, catwalks, wharf logs, train rails and stops, utility lines and hangers, etc.	No visible distress, or corrosion on less than 10 percent of surface.	Corrosion or deterioration of coating on 10 to 50 percent of surface, but no section loss of base material.	Section loss is present or element has major wear marks, but assessment has determined element's functionality or capacity is not compromised.	Section loss is present and distortion or displacement is significant enough to affect element's immediate functionality or capacity
	CONX	Connection	Connection distress in metal and other material elements. Connections include items such as heavy hex structural bolts, post-installed anchors, through-bolts, anchor rods etc.	No connection distress; connection is in place and functioning as intended.	Loose fasteners or minor pack rust without distortion is present, but connection is in place and functioning as intended.	Missing fasteners or broken / cracked welds; pack rust with distortion may be present; visible section loss on fastener of up to 20 percent OR assessment has determined connection's remaining capacity is not compromised.	Missing fasteners, broken/cracked welds, and/or pack rust cause translation and/or rotation preventing the connection from functioning as intended. Section loss on fastener in excess of 20 percent. Distress is significant enough to affect element's capacity.
	CRKM	Cracking	Fatigue cracking in metals and other material elements	No cracking.	Cracks have self-arrested or have been arrested.	Cracks are not arrested.	Cracks are not arrested and may affect load-path redundancy.
	DBIM	Debris impaction	Damage to any element by debris impaction	No debris observed or shallow debris present (no hard-packed debris) with no effect on element performance.	Debris present (including hard-packed) with minor or no effect on element performance.	Debris present with moderate effect on element performance.	Debris present with severe effect on element performance.
	PMAR	Condition of paint and markings	Readability or visibility of marking	Marking is clear and legible.	Marking is faded or illegible on 10 to 25 percent of surface.	Marking is faded or illegible on 25 to 50 percent of surface.	Marking is missing, faded or illegible on more than 50 percent of surface.

Type	Code	Condition Name	Condition Definition	Condition States			
				CS1 (Good)	CS2 (Fair)	CS3 (Poor)	CS4 (Severe)
Ancillary	TRAL	Track Joint Mismatch or Distortion. [See Table Note 2]	Mis-alignment of rails at track joints of either tread (top surface) or gage (inner surface) at ends of rails, or distortion of rails.	No misalignment	Misalignment or distortion less than 1/4 inch.	Misalignment or distortion greater than 1/4 inch where assessment has determined element's functionality is not compromised.	Misalignment or distortion greater than 1/4 inch that affects element's functionality.
	TRFS	Track Fissure, Fracture, or Split. [See Table Note 2]	Transverse or compound fissure or fracture in rail track, head or web splitting, or other rail defect.	No defect	For transverse defects: affects less than 5 percent of rail-head cross section. For longitudinal defects: defect is less than 1 inch in length.	For transverse defects: defect affects more than 5 percent of rail-head cross section. For longitudinal defects: defect is greater than 1 inch in length. Defect has been strengthened or assessment has determined functionality is not compromised.	For transverse defects: affects more than 5 percent of rail-head cross section. For longitudinal defects: defect is greater than 1 inch in length.
	TRSF	Track Surface Condition [See Table Note 2]	Rail head surface damage, flattening, or corrosion	No defect	Minor pitting, flattening, or other surface defects.	Section loss of rail; surface flattening of up to 3/8 inch deep and up to 8 inches long.	Surface defects greater than 3/8 inch in depth and more than 8 inches in length.

Type	Code	Condition Name	Condition Definition	Condition States			
				CS1 (Good)	CS2 (Fair)	CS3 (Poor)	CS4 (Severe)
Protective Coatings	CHLK	Chalking	Chalking in metal protective coatings	No chalking.	Surface dulling.	Loss of pigment.	N/A
	FRPW	Fiber-reinforced polymer wrap	Condition of fiber-reinforced (Glass, Carbon, or other material) polymer permanently bonded to a member. Also may apply to unbonded plastic wrap, such as for timber piles.	No visible distress.	Minor bubbles or blisters. Minor abrasion to surface layer.	Delamination, gouges, holes, tears, or splits in material but assessment has determined capacity or functionality of wrap is not compromised.	Delamination, gouges, holes, tears, or splits in material that affects capacity or functionality of wrap.
	GALV	Galvanized zinc coating	Condition of galvanized zinc patina on steel elements.	No white or red corrosion products. Surface may be bright and shiny, spangled, or matte gray.	White rust (zinc oxide) is visible on surface.	Red rust is visible through coating on less than 5 percent of the local area.	Red rust exceeds 5 percent of the local area.
	PEEL	Peeling/ bubbling/ cracking	Peeling, bubbling, or cracking in protective coatings	No peeling, bubbling, or cracking.	Finish coat exhibits peeling, bubbling, or cracking.	Finish and primer coats exhibit peeling, bubbling, or cracking.	Substrate is exposed.
	WEAR	Wear	Wear of protective coating. Includes wear from abrasion, weathering, or consumption (i.e. galvanized zinc).	No wear.	Substrate not exposed, coating showing wear or abrasion.	Substrate partially exposed; thickness of the coating is reduced.	Substrate exposed; protective coating is no longer effective.
	WETH	Weathering Steel Patina [See Table Note 3]	Condition of weathering steel patina (oxide film).	Uniform color pattern, dark brown with some lighter reddish- or purple-brown spots. Patina is adhered.	Dark brown but with minor color variation. Small loose flakes on surface but underlying patina is adhered.	Dark brown with black blotches, non-uniform texture. Medium (up to 1 inch) sized flakes.	Dark brown, black patina with widespread blotchiness. Laminar sheets or large flakes. Patina is no longer effective.

Type	Code	Condition Name	Condition Definition	Condition States			
				CS1 (Good)	CS2 (Fair)	CS3 (Poor)	CS4 (Severe)
Wearing Surface	ABWC	Abrasion / wear	Abrasion or wear in concrete elements or wearing surfaces (including cementitious and bituminous).	No abrasion or wear.	Coarse aggregate is exposed but remains secure in concrete matrix.	Coarse aggregate has been exposed and is loosened from concrete matrix due to wear.	N/A
	CRKC	Cracking	Cracking in concrete elements and wearing surfaces (including cementitious and bituminous materials)	Insignificant cracks i.e., or moderate-width cracks that have been sealed.	Unsealed moderate-width cracks i.e., or unsealed moderate map cracking.	Wide cracks i.e., or heavy map cracking. For structural elements, this excludes cracks associated with reduction of structural capacity (e.g., bond splitting cracks, shear, bending, or torsional stress cracks)i.e.,	Wide cracks associated with reduction of structural capacity or functionality (e.g., i.e., loss of bond, shear, bending, or torsional stress cracks).
	DLSP	Delamination/ spall (partial-depth)	Spalls or delamination in concrete elements or wearing surfaces. Distress does not extend through full thickness of element.	No delaminated or spalled areas.	Delaminated. Spall is less than 1 inch in depth or less than 6 inches in diameter. Patched area is sound. Partial depth pothole in wearing surface.	Spall greater than 1 inch in depth or greater than 6 inches in diameter.	Significant spalls or distress to patched areas is significant enough to affect element's immediate functionality or capacity
	PTCH	Patched area	Patched areas in concrete or wearing surfaces. In concrete, limited to partial-depth repairs. Full-depth repairs are considered equivalent to an original element	Sound patched areas.	Patched area is unsound or showing distress.	Patched area is unsound and some or all of the patch has spalled. Corrosion staining is observed in patch. Does not compromise element's functionality or capacity. '	Unsound patched areas are significant enough to affect element's immediate functionality or capacity

Table Notes

1. The selected condition state for concrete cracks should reflect the generalized distress and importance of the cracking. The inspector should consider width, spacing, location, orientation, exposure, and structural implications (i.e. shear crack vs flexural crack). It is not expected that inspectors measure every crack; however, general guidelines for prestressed and conventionally-reinforced concrete are as follows:

Significance / Corresponding Condition State	**Crack Width 'x' (in.)**	
	Prestressed	**Conventionally-Reinforced**
Insignificant (CS1)	$x < 0.004$	$x < 0.012$
Moderate (CS2)	$0.004 < x < 0.009$	$0.012 < x < 0.050$
Wide (CS3 or CS4)	$x > 0.009$	$x > 0.050$

2. Track defect conditions adapted from *Track and Rail and Infrastructure Integrity Compliance Manual: Volume II - Chapter 1 - Track Safety Standards - Classes 1 through 5*, published by Federal Railroad Administration, Jan 2014. Accessible at: https://www.fra.dot.gov/Elib/Details/L04404

3. Weathering steel descriptions from Crampton, D.D., Holloway, K.P. and Fraczek, J., *Assessment of Weathering Steel Bridge Performance in Iowa and Development of Inspection and Maintenance Techniques*, Final Report SPR 90-00-RB17-012, February 21, 2013. Accessible at http://publications.iowa.gov/14956/1/Iowa_Weathering_Steel_Final_Report_2-21-2013.pdf.

APPENDIX F - TEMPLATE DOCUMENTATION AND REPORTING FORMS

- Inventory Record
- Inspection History
- Inspection Summary
- Follow-up Actions
- Elemental Inspection Form

Property:	Northside Turning Basin	**Asset ID:**	CD 29
Asset Type:	Wharf	**Year of Original Construction:**	1972
Wharf Type:	Open Platform with Open Structure	**Year(s) of Significant Modifications or Repairs[1]:**	1997
Wharf Usage:	General cargo, break bulk	**Date of Last Inventory Record Update:**	March 22, 2017
Inspection Frequency:	Above water: 3 yr Underwater: 6 yr		

Asset Geometric Data

Area (sf):	Wharf Deck: 40,952 Apron: 69,548 Total: 110,500	**Deck Elevation above Average Tide:**	15 ft. 2 in.
Structure Length:	600 ft.	**Channel Depth at Fender:**	34ft 6 in.
Structure Width:	Deck: 600ft.	**Channel Depth at Bulkhead:**	7 ft. 0 in.

Structure Load Rating

Uniform Load	750 psf	**Railroad:**	3 inactive lines, 2 inactive crane rails
Shore Crane:	300T	**Truck Rating:**	HS20-44
Fender Design (Max. Vessel):	Not available		

Asset History

CD 29 is located near the easternmost edge of the Turning Basin at the last corner in the northern shoreline east of the I-610 Bridge. The original construction drawings are dated 1972, and a significant modification was made during a rehabilitation project in 1997. This included including the addition of a new steel-framed and timber lagging fender system, as well as the replacement of damaged beam and strut elements, and deck repairs. This fender system is still currently in place.

Reference Drawing List

Drawing Set	Title	Date	Description
C129-14	A Container Marshalling Area at Wharf 29	May 10, 1972	Original Construction Drawings
C129-21	Repair of Wharf and Fender System at Wharves Nos. 29, 30 and 31	April 28, 1997	Superstructure Repairs and Installation of New Steel-Framed and Timber Lagging Fender System

[1] Significant modifications: Work that altered the structure's footprint or changes structural components.
Significant repairs: Repair work in excess of 10 percent of the area or length of a structural component.

Structural Components & Elements

Component / Element(s)	**Description**
Deck	Reinforced concrete deck, 69 feet wide, spanning from deck beam to deck beam.
– RC Deck	One-way reinforced deck, 8-inch thick, multi-span. The deck is depressed in elevation for a fill slab over most of the structure width. The deck topside is exposed in the first span along the length of the wharf.
Slabs & Wearing Surfaces	Approximately two-thirds of the deck are is covered by a concrete fill slab.
– RC Wearing Surface	Concrete fill slab, 7-1/2 inches thick, with nominal temperature and shrinkage reinforcement.
Superstructure	Multiple deck beams spanning between shear walls.
– RC Deck Beam	Tapered reinforced concrete beam from 16 to 22 inches wide by 42 or 49 inches deep. Additional deck infill beam over shear walls.
Substructure	Shear walls bearing on cap beams over drilled shafts. Bracing strut beams between caps.
– RC Shear Wall	Reinforced concrete wall, 12-inches thick.
– RC Pilasters	Reinforced concrete pilasters, 2-feet 4-inches wide at fascia, 1-foot 4-inches wide at bulkhead.
– RC Columns	Reinforced concrete columns, 1-foot 4-inches by 2-feet.
– RC Pile Cap	Reinforced concrete pile cap, nominally 3 feet 4-inches wide by 3-feet deep. Placed on top of drilled shafts.
– RC Strut	Reinforced concrete strut beams spanning between pile caps, 14-inches wide by 20-inches deep
– CS Pile	Steel drilled shafts underneath pile caps, generally 30-inch or 24-inch diameter sections.
Bearings	Bearings for deck beams on shear walls at expansion joints located at Bent joints 10 and 17.
– Partially-fixed bearing	Sliding bearings consisting of Type 302 stainless steel plates on top of “Lubrite” bearings.
Joints	Transverse expansion joints exist at Bents 1, 10, 17, and 26.
– Armored Joint without Seal	Armored joint without seal, at Bents 1, 10, 17, and 26.
Bulkhead	Tied-back bulkhead wall extending from mudline to deck.
– CS Bulkhead Wall	Steel sheet pile wall extending from mudline to deck.
– RC Bulkhead Pile Cap	RC bulkhead pile cap at top of sheet piles at deck elevation. Nominally 2-feet 6-inches wide by 2-feet deep.
– RC Bulkhead Wale Beam	RC bulkhead wale beam encapsulating tie rod connections near waterline. Nominally 3-feet 3-inches wide by 2-feet deep.

Component / Element(s)	Description
– CS Bulkhead Tie Rod	3 1/2-inch diameter tie rods typically spaced at approximately 12-feet 6-inches on center.
– RC Dead Man	Reinforced concrete dead man approximately 53-feet 6-inches landward of bulkhead. Nominally 1-foot 9-inches deep by 6-feet tall.

Berthing Components & Elements

Component / Element(s)	Description
Fender System	Steel framed and timber lagging fender system, installed as part of the 1997 repairs.
– TIM Fender Facing	12x12 timber facing members outboard of the fender system support framing.
– GS Stay Chains	Stay chains include: diagonal stay chains spaced intermittently along fender; short stop chains restraining outward movement at each bent.
– OTH Cylindrical Rubber Fender Absorption Unit	Energy-absorbing cylindrical rubber fender units located at each bent line between the fender support piles and the concrete wharf structure.
– CS Fender Support Framing	Steel fender support framing consisting of top and bottom W21x132 chords, vertical HP 12x53 struts and WT4x10.5 diagonal bracing.
– CS Fender Piles	Steel fender piles with coal tar epoxy coating, located at each bent line. Typically HP 14x102 sections.
Mooring System	Cast steel mooring cleats located at bents 3, 6, 9, 12, 15, 18, 21, and 24. Intermediate mooring bits in the fender framing.
– MT Cleat	Cast steel mooring cleats attached to thickened portions of the deck with through bolts.
– MT Bollard	Small mooring bollards located at various bays within the fender support framing for small craft usage.

Shoreline Components & Elements

Component / Element(s)	Description
Unprotected Shoreline	Shoreline is shown sloping from bulkhead wall to channel bottom with exposed native soils.

Ancillary Components & Elements

Component / Element(s)	Description
Utility Systems	
– GS Supports	Utility hangers for waterline below deck, near fascia deck beam.
Paint and Markings	

Component / Element(s)	**Description**
– Paint and Markings	Numerical markings on deck topside at 50-feet on center denoting the station along the wharf.
Guards	
– TIM Wharf Logs	Timber wharf logs located on the deck along the channel side of the structure.
Crane and train rails	
– Train rails	Three train tracks are present with various crossovers. Two tracks are located in between the crane rails, with a track toward the landside.
– Crane rails	One pair of gantry crane rails was installed as part of original construction. Gantry cranes have been removed and these rails are no longer in service.
Personnel access systems	
– CS Ladder	Three metal wharf ladders at the fascia of structure.
– MT Manhole Cover	Multiple metal hatches in deck to provide access to utility lines below.

Figures

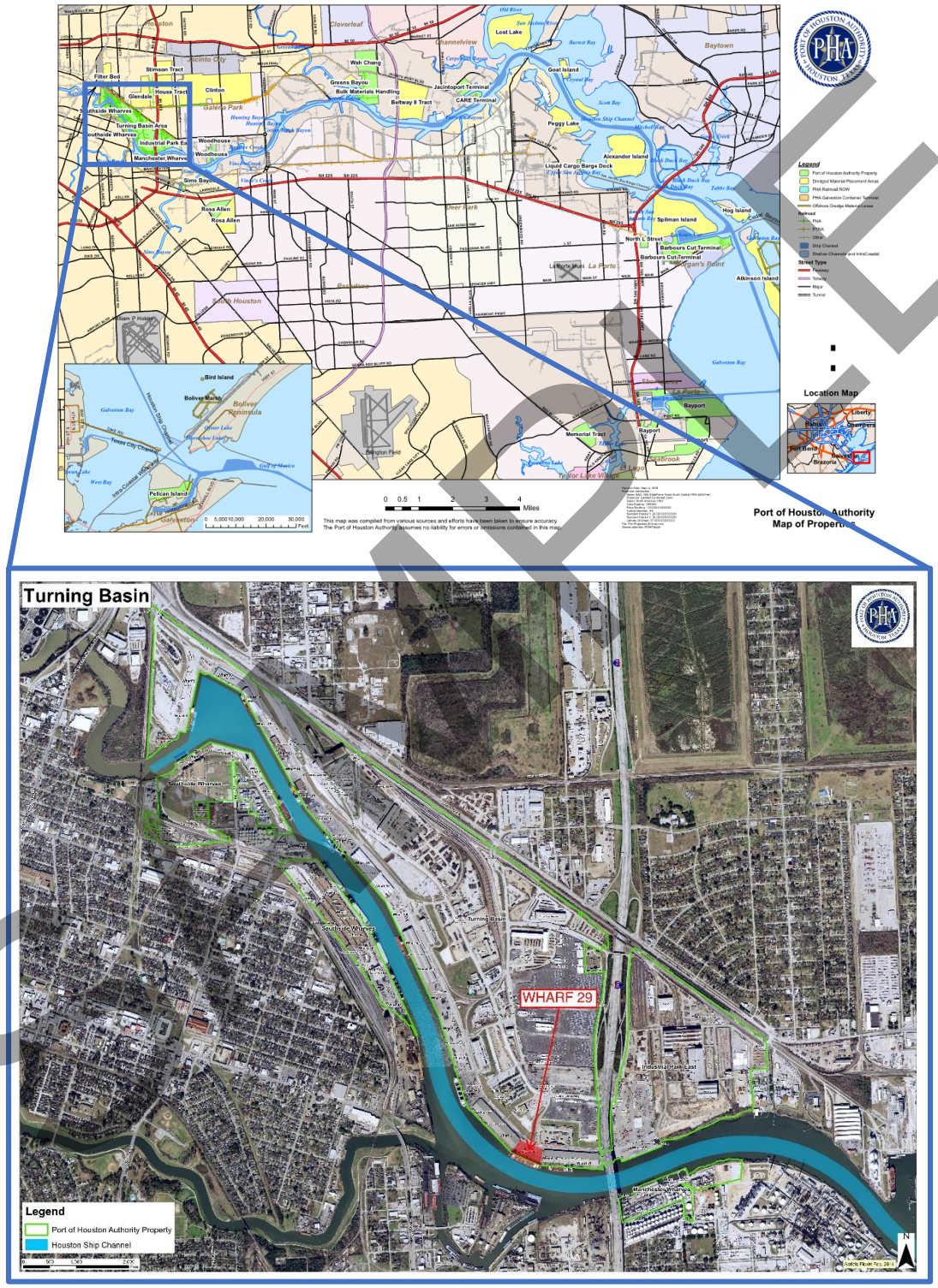


Figure 1. Asset Location

Figure 2. Aerial view of structure and immediate vicinity.

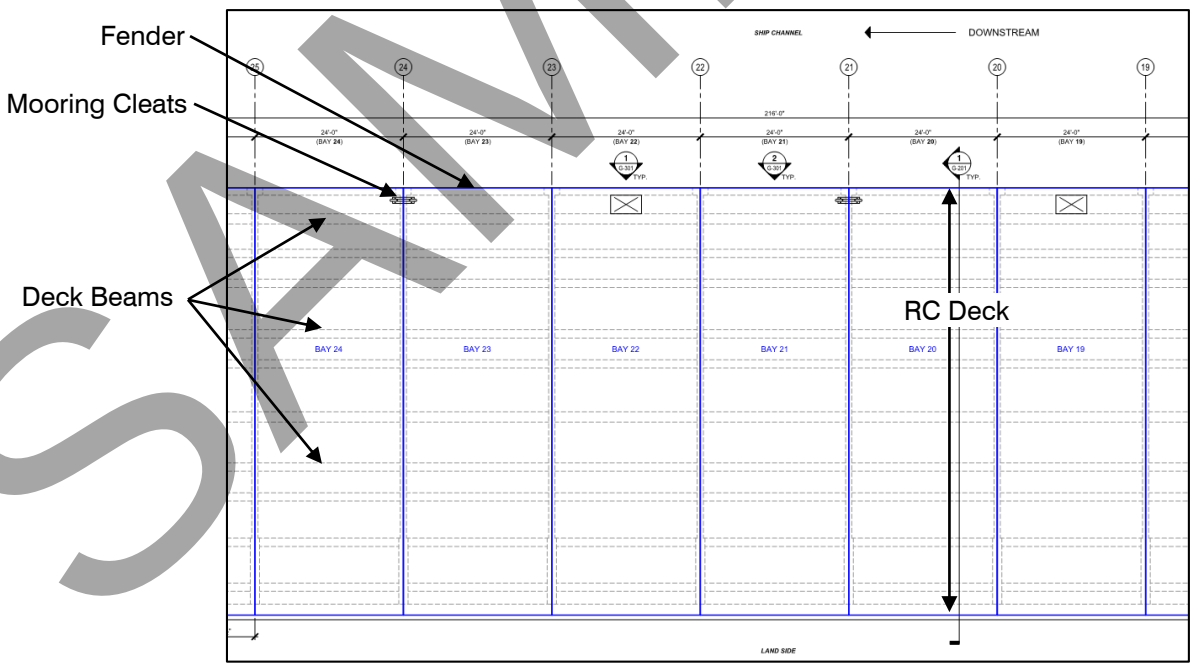


Figure 3. Typical Partial Plan of Structure.

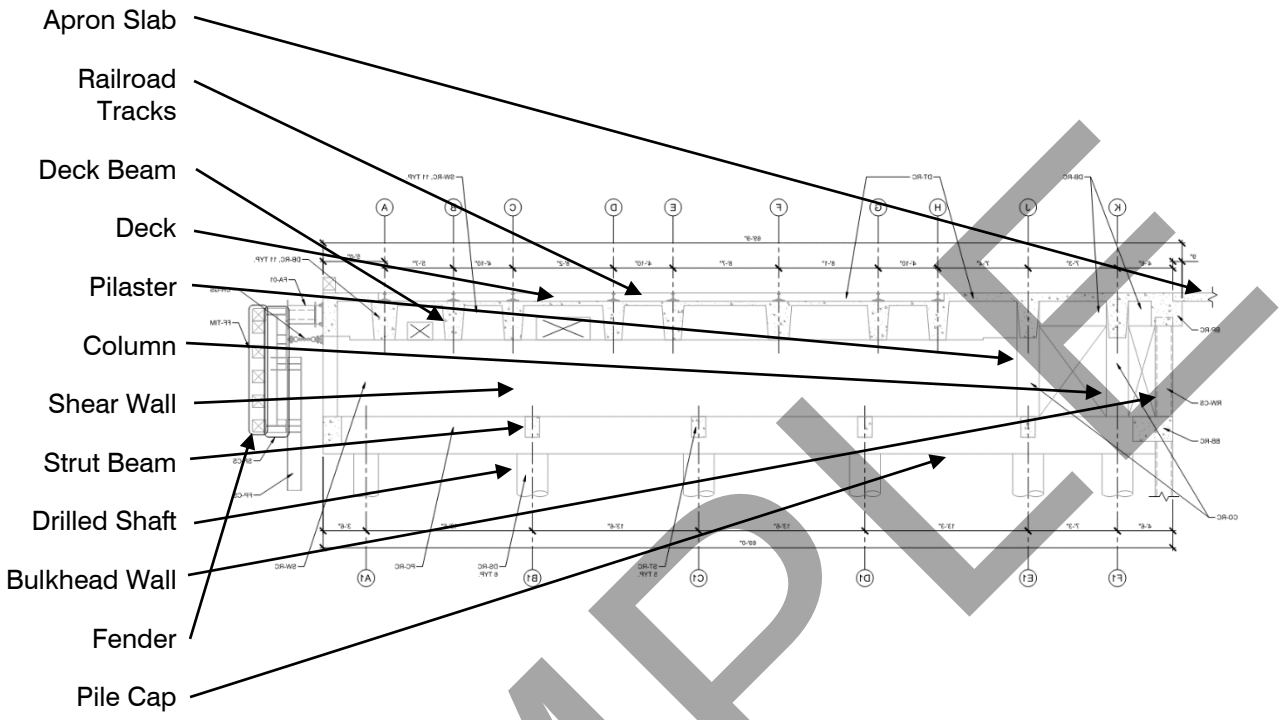


Figure 4. Typical Section through Structure.

Revision History

Rev. No.	Reported by:	Date	Verified by	Date	Comments
0	P. Marra	3/7/17	J. Kurth	3/21/2017	Baseline

Property:	Southside Turning Basin	**Asset ID:**	CD 41
Asset Classification:	Wharf	**Year of Original Construction:**	1923
Inspection Frequency:	Above water: 3 yr Underwater: 6 yr	**Year(s) of Significant Modifications or Repairs**	1924, 1926, 1937, 1950

Dates of Inspections, Asset, and Component Ratings

Date	2017-03					
Inspection Type	Baseline (Limited)					
Inspection Firm: Above Water	WJE					
Inspection Firm: Underwater	N/A					
Asset Condition Rating (ACR)	**0**					
Structural Components (SR)	**0**					
Deck	2					
Superstructure	1					
Substructure	3					
Bulkhead	N/A					
Functional Components (FR)	**0**					
Slabs & Wearing Surfaces	N/A					
Joints & Bearings	N/A					
Fender System	1					
Mooring System	5					
Shoreline	2					
Ancillary Components	1					

Property:	Northside Turning Basin	**Asset ID:**	CD 29
Inspection Type	☒ Baseline ☐ Routine ☐ Special	**Inspection Date(s):**	March 1, 2017
Scope of Inspection	Entire Asset, Above Water		
Inspection Firm(s):	**Prime**: Wiss, Janney, Elstner Associates, Inc. (WJE), with assistance from Port of Houston Authority staff		
	Underwater: Not Performed		
Reported By:	Casey Jones, WJE	**Report Date:**	March 22, 2017
FICAP Manual Version/Date:	Revision 0 / February 2017	**Variances from FICAP Procedure:**	None

Seal of Responsible Engineer

I hereby certify this inspection was performed under my direct supervision and control and to the best of my professional knowledge complies with the FICAP Manual and applicable codes.

Signed: _____

Name: Carl J. Larosche, PE

Texas License No.: 91870

Date: April 5, 2017 Expires: March 19, 2018

Seal

Inspection Team Members

Project Manager: Chuck Larosche (WJE)
Inspection Team Leader(s): Jonah Kurth (WJE), Matthew Gries (WJE), Kurt Tyler (WJE), Jeremiah Fasl (WJE)
Inspection Team Members:
Casey Jones (WJE), Patrick Marra (WJE), Oscar Zavala (PHA), Jeff Scott (PHA)

Underwater Team Leader: N/A
Underwater Team Member: N/A

Overall Asset Condition

CD 29 was overall in satisfactory condition with all structural and non-structural components functional at the time of the inspection.

Structurally, a few deficiencies were observed. With respect to the superstructure, follow-up inspections should be conducted on select deck beams in order to determine the impact of observed deterioration on their structural capacity, primarily due to shear cracks on the frontal beams and isolated severe corrosion on exposed reinforcement. The deck exhibited minor to moderate distress, primarily due to cracks and related efflorescence, but still was structurally adequate for its intended use. A thick concrete wearing surface covers most of the deck area and has helped protect the underlying structural component.

Fender, mooring, and ancillary components were in fair to satisfactory condition. The coating of the fender system steel framing has aged and deteriorated at the waterline, such that the underlying steel substrate is exposed. A few isolated timber facing elements were damaged. Many of the coatings on the mooring cleats exhibited wear, and similarly, coatings on the metal ladders and utility supports were also partially worn and weathered. The set of train rails nearest to the waterline exhibited moderate corrosion and some section loss on the running, but the sets of tracks toward the landside were generally in better condition.

The overall asset condition rating (ACR) for the structure is 77.

Structural Component Ratings and Element Summary

Component / Element(s)	Rating	Comments
Deck	**5**	The deck was in serviceable condition with typical minor-width cracks on the topside and localized spalling with exposed reinforcement on the bottom.
– RC Deck	5	Cracks and abrasion were widespread on the exposed portions of the deck topside, with partial-depth spalling and exposed reinforcement at isolated locations (Figure 1). The deck underside was in good condition with spalling, exposed reinforcement, and efflorescence observed, typically in localized locations or at deck penetrations (Figure 2). Overall, less than 1 percent of the deck topside or underside was spalled or delaminated and these conditions did not affect the strength or functionality of the deck.
Slabs & Wearing Surfaces	**4**	Moderate abrasion and wear was widespread on the top surface. A few areas had deeper gouges and spalls but did not expose the deck substrate.
– RC Wearing Surface	4	
Superstructure	5	The superstructure was in satisfactory condition, with some moderate defects noted in a limited number of locations. Figure 3 shows typical deck beam arrangement.
– RC Deck Beams	5	Several of the front deck beams exhibited shear-type cracks, which have an associated follow-up action for further review. One deck beam had severe corrosion and some section loss on exposed reinforcement.
Substructure	**5**	The substructure was in satisfactory condition, with few deficiencies observed. Figure 4 shows typical above water conditions for the substructure.

Component / Element(s)	Rating	Comments
– RC Shear Walls	6	Some vertical, shrinkage-type cracks were observed in the shear walls.
– RC Pile Caps	6	Localized cracks, spalls, and exposed reinforcement were observed in the pile caps.
– RC Struts	5	Moderate-width horizontal cracks were observed on the sides of many of the struts. Many of the struts appeared to have shotcrete repair material added to the top of the element, and some of this material had wide cracks on the top surface.
– RC Columns	5	The reinforced concrete columns were mostly in good condition. One isolated column had a moderate spall near its interface with the beam above.
– RC Pilasters	5	Pilasters were mostly in good condition; however, several pilasters on the water side of the structure exhibited spalls and exposed reinforcement.
Joints and Bearings	**4**	Joints showed signs of debris impaction, distortion, and wear that could affect their functionality, but bearing elements were satisfactory.
– Partially-Fixed Bearings	5	Bearing elements located along gridlines 10 and 17 were in satisfactory condition. Some light surface corrosion was observed on the bearing plates, but no evidence of binding or locking of the sliding surfaces was observed.
– Armored Joint without Seal	4	Debris impaction was common among the length of each joint. In localized areas, distortion and damage were observed including missing plates (Figure 5).
Bulkhead	**5**	Bulkhead elements were in satisfactory condition and appeared to be serving their intended purposes.
– RC Bulkhead Wale Beam	5	The bulkhead wale beam exhibited localized distress, but was in overall good condition.
– RC Bulkhead Pile Cap	6	The bulkhead pile cap was in good condition with only minor, localized distress noted.
– CS Bulkhead Wall	4	Corrosion, peeling, and wear of the bulkhead wall coating was observed at many locations above the bulkhead wale beam (Figure 6).
– CS Bulkhead Tie Rod	N/A	Buried - inaccessible for inspection.
– RC Dead Man	N/A	Buried - inaccessible for inspection.

Berthing Component Ratings and Element Summary

Component / Element(s)	Rating	Comments
Fender System	**4**	The fender system was in satisfactory condition; however, steel elements exhibited minor to moderate localized corrosion and some fender timber facings are damaged or missing. More than one third of the rubber absorption units also exhibited moderate to severe deterioration that may locally reduce the energy-absorption capacity of the fender.
– GS Stay Chains	5	Stay chains were in generally good condition and appeared to be functioning properly. One shear chain was missing.

Component / Element(s)	Rating	Comments
– OTH Cylindrical Rubber Fender Absorption Unit	4	Several energy absorption units exhibited moderate to severe bulging and tears which could affect their ability to absorb berthing energy (Figure 7).
– TIM Fender Facing	5	Fender facing was in generally good condition; however, several timbers were damaged or missing (Figure 8).
– CS Fender Piles	4	Moderate corrosion was observed on several steel piles, as well as potentially deficient connections between isolated members. Coating deterioration was widespread at the waterline.
– CS Support Framing	5	Support framing was in generally good condition, with minor to moderate corrosion being observed in localized locations.
Mooring System	**5**	The majority of the mooring system, including both bollards and cleats, is in serviceable condition with only minor deterioration.
– MT Bollard	5	Bollards exhibited peeling of coating as well as minor corrosion of the base metal.
– MT Cleat	5	Cleats exhibited peeling of coating as well as minor corrosion of the base metal.

Shoreline Components Ratings and Element Summary

Component / Element(s)	Rating	Comments
Protected Shoreline	**N/A**	Not inspected
Unprotected Shoreline	**N/A**	Not inspected

Ancillary Components Ratings and Element Summary

Component / Element(s)	Rating	Comments
Ancillary Components (overall)	**4**	Overall, ancillary elements on the structure are functional, with some minor to limited moderate defects. The two most severe defects were corrosion-related section loss of set of train tracks nearest to the channel and general deterioration of the wharf logs.
Crane and Train Rails	**3**	The set of train tracks nearest to the waterline exhibited moderate corrosion and some section loss on the rails, but the two sets of tracks toward the landside were generally in better condition. Some isolated distortion of elements at crossovers and switches was observed that may affect their usage.
Guards	**3**	Numerous wharf logs were missing or not securely fastened to the deck (Figure 9).
Paint and Markings	**5**	Paint and marking on the deck were legible but typically faded (Figure 10).
Personnel access systems	**4**	Hatches typically exhibited minor to moderate corrosion and distortion or debris impaction. The steel ladders exhibited minor peeling and corrosion of their coating.
Utility Supports	**4**	The majority of utility supports were in serviceable condition; however, multiple were experiencing moderate to severe corrosion.

Figures

Figure 1. Partial-depth spalls observed on the deck topside.

Figure 2. Localized longitudinal crack with spall and corroding reinforcing steel at deck penetration.

Figure 3. Typical arrangement of deck beams in an expansion joint bay, looking toward the channel from the land side of the wharf.

Figure 4. Typical view of above-water substructure, looking toward the land side of the wharf from the front strut.

Figure 5. Debris is impacted along the length of the joint. The arrow points to missing plates.

Figure 6. Coating failure and corrosion of the bulkhead wall observed below a storm water drain.

Figure 7. Fender absorption unit exhibiting bulging and splitting of the rubber.

Figure 8. Overall view of a portion of the fender from the channel.

Figure 9. A wharf log detached from the deck and fallen onto the fender system.

Figure 10. View of typical condition of paint and markings on the deck topside.

Rating Definitions

Ratings tables below from PHA FICAP Manual Rev. **0** , dated **February 2017**

Table 6.1. Ratings for Structural and Berthing Components

Rating	Description
6 Good	Minor or no problems noted. Also applies to newly constructed or rehabilitated components.
5 Satisfactory	Minor defects, damage or deterioration - not extensive.
4 Fair	Extensive minor or limited moderate defects, damage or deterioration. Structural capacity of primary structural components and functional use of fender or mooring systems are not affected.
3 Poor	Moderate or extensive defects, damage or deterioration that affects structural capacity of primary structural components or functional use of fender or mooring system components.
2 Serious	Defects, damage or deterioration significantly reduces structural capacity of primary structural components or reduces functional use of fender or mooring systems.
1 Critical	Advanced defects, damage or deterioration with localized failure(s) of components imminent or observed. Immediate load or use restrictions, including closing of the asset should be considered.
Applicable Component Types: Deck, superstructure, substructure, bearings, bulkheads, mooring and fender systems.	

Table 6.2: Ratings for Shoreline Components

Rating	Description
6 Good	Minor or no problems noted. Also applies to newly constructed or rehabilitated shoreline components.
5 Satisfactory	Minor defects, damage or deterioration - not extensive.
4 Fair	Protected shoreline: Extensive minor or limited moderate defects, damage or deterioration observed but does not affect shoreline protection. Unprotected shoreline: Extensive minor or limited moderate indications of shoreline beginning to slump. May be minor movement of shoreline.
3 Poor	Protected shoreline: Moderate or extensive deterioration or displacement that affects shoreline protection. Unprotected shoreline: Moderate or extensive indications of shoreline slumping or movement.
2 Serious	Protected shoreline: Deterioration, displacement, or breakage significantly affects the shoreline protection and local failures are possible. Unprotected shoreline: Shoreline is being eroded. Local slump or embankment failures are present. Use restrictions may be necessary for roadways, railways and working areas near shoreline.

1 Critical	Protected shoreline: Very advanced deterioration, displacement, or breakage with localized failure(s) of primary shoreline protection imminent or observed. Shoreline is being eroded and/or shoreline movement has occurred. Unprotected shoreline: Widespread erosion and/or slump or embankment failures have occurred. More widespread failures are possible or likely to occur. Immediate actions, such as emergency shoreline protection measures, use restrictions, or barricading of roadways, railways and working areas near the shoreline should be considered.
Applicable Component Types: Protected shoreline, unprotected shoreline.	

Table 6.3: Functional Ratings for Ancillary Components

Rating	Description
6 Good	Minor or no problems noted. Also applies to newly constructed or rehabilitated protective components.
5 Satisfactory	Minor defects, damage or deterioration - not extensive.
4 Fair	Extensive minor or limited moderate defects, damage or deterioration. All primary elements and their attachment to the asset are sound and functional purpose/use of the component is not affected. Minor repairs or maintenance may be required.
3 Poor	Moderate or extensive defects, damage or deterioration that affects functional purpose/use of the component or compromises attachment of the component to the asset.
2 Serious	Defects, damage or deterioration significantly affects functional purpose/use of the component and/or local failures of the attachment to the asset are present.
1 Critical	Advanced damage or deterioration has resulted in frequent imminent or observed failure(s) of the attachment of the component to the asset. The component may no longer serve its functional purpose/use and/or conditions are present that may lead to property damage or environmental damage. Immediate repairs or other protective measures should be considered, and/or immediate use restrictions should be considered for components affected.
Applicable Component Types: Utility system supports, paint and markings, crane and train rails, personnel access systems.	

Property:	Barbours Cut Terminal	**Asset ID:**	BCT 5
Inspection Type:	☒Baseline ☐Routine ☐ Special	**Inspection Date:**	February 27-28, 2017
Scope of Inspection	Entire Asset, Above Water		
Inspection Firm(s):	**Prime**: Wiss, Janney, Elstner Associates, Inc. (WJE), with assistance from Port of Houston Authority staff		
	Underwater: Not Performed		
Reported By:	Kurt Tyler, WJE	**Report Date:**	March 22, 2017

Follow-up Actions

Item No.:	1	**Priority:**	☒Priority ☐Routine
Component:	Deck		
Element Type:	RC Deck	**Element ID(s):**	DU 30-1, DU 30-2, DU 31-1, DU 31-2, DU 31-3, DU 32-1, DU 32-2, DU 32-3, DU 33-3, DU 35-1, DU 35-2, DU 36-1, DU 36-2, DU 36-3, DU 37-1, DU 37-2, DU 37-3, DU 38-1, DU 38-2, DU 38-3, DU 39-2, DU 39-3, DU 40-3, DU 41-1, DU 41-3, DU 42-3, DU 43-3, DU 44-1, DU 44-2, DU 46-2, DU 47-1, DU 47-2, DU 48-1
Condition Identified:	Cracking present at drop slab surrounding drilled shafts, often in radial pattern.		
Reason for action:	Condition may reflect underlying deficiency in structure.		
Recommended Action:	Follow-up investigation (In-depth Inspection) to include structural calculations.		

Figure 1. Typical cracking pattern, cracking outlined for visibility

Item No.:	2	**Priority:**	☐Priority ☒Routine
Component:	Fender System		
Element Type:	CS Support Framing	**Element ID(s):**	SF 2-1, SF 3-1, SF 5-1, SF 6-1, SF 7-1, SF 8-1, SF 9-1, SF 10-1, SF 12-1, SF 13-1, SF 14-1, SF 20-1, SF 21-1, SF 25-1, SF 26-1, SF 28-1, SF 29-1, SF 32-1, SF 34-1, SF 35-1, SF 37-1, SF 39-1, SF 40-1, SF 41-1, SF 43-1, SF 44-1, SF 45-1, SF 46-1, SF 47-1
Condition Identified:	Severe corrosion section loss of horizontal framing member connections to fender piles along water line.		
Reason for action:	Many of the horizontal members are no longer functional as the corrosion has consumed full thickness of the member at the connections. These members have been replaced in several locations along the length of the wharf.		
Recommended Action:	Continue replacement plan for remaining severely deteriorated members.		

Figure 2. Severe corrosion-induced deterioration of horizontal fender framing member connection at fender pile near water line (yellow circle).

Figure 3. Close-up of deteriorated connection.

Item No.:	3	**Priority:**	☒Priority ☐Routine
Component:	Fender System		
Element Type:	TIM Facing	**Element ID(s):**	FF 33-1
Condition Identified:	Missing timber facing from horizontal support framing at SF 33-1 and FP 33-1.		
Reason for action:	Vessel hulls may be damaged from berthing at this location.		
Recommended Action:	Replace timber facing members.		

Item No.:	4	**Priority:**	☒Priority ☐Routine
Component:	Berthing		
Element Type:	MT Bollard	**Element ID(s):**	BD 4-1, BD 8-1, BD 12-1, BD 16-1, BD 20-1, BD 24-1, BD 28-1, BD 32-1
Condition Identified:	Severe corrosion deterioration of mooring bollards.		
Reason for action:	Section loss of metal evident and capacity is reduced.		
Recommended Action:	Replace mooring bollards.		

Figure 4. Severe corrosion deterioration of mooring bollard, typical.

Item No.:	5	**Priority:**	☐Priority ☒Routine
Component:	Joints		
Element Type:	Armored Joint with Seal	**Element ID(s):**	JN 1-1, JN 1-2, JN 3-1, JN 5-1, JN 11-1, JN 13-1, JN 16-1, JN 16-2, JN 16-3, JN 18-1, JN 20-1, JN 22-1, JN 24-1, JN 26-1, JN 28-1, JN 30-1, JN 32-1, JN 32-2, JN 32-3, JN 34-1
Condition Identified:	Impact damage to and raveling/spalling of concrete surrounding joint protection plates.		
Reason for action:	Deterioration of element.		
Recommended Action:	Repairs of joint plates and concrete surrounding joints; detailed repair drawings are recommended.		

Figure 5. Typical distress at armored joints.

Follow-up Actions Log

Item No.	Priority	Recommended Action	Assigned To	Assigned By	Date
1	Priority	Follow-up investigation			
2	Routine	Continue horizontal framing member replacements			
3	Priority	Replace missing timber facing			
4	Priority	Replace severely-deteriorated bollards			
5	Routine	Repair deteriorated armored joints			

Sample Component Summary Table

Structural Components: Condition State Summary

Component	Element Group	Units	Condition State Code	Total Quantity	Inaccessible	CS1	CS2	CS2 [NC]	CS3	CS3 [NC]	CS4	CS4 [NC]
Deck	DT	SF	--	48178	48178	–	–	–	–	–	–	–
	DT Total			48178	48178	–	–	–	–	–	–	–
	DU	SF	--	33183	10389	15161	–	–	–	–	–	–
			CORR	–	–	17	15	–	–	–	–	–
			CRKC	–	261	40	254	–	30	–	–	–
			DLSF	–	–	–	–	–	15	–	58	–
			DLSP	–	6	432	693	[432]	1328	[972]	837	[596]
			EFRS	–	–	–	247	[149]	17	–	–	–
			EXPR	–	–	–	385	[631]	862	[1216]	722	[749]
			PTCH	–	83	140	736	[138]	401	[25]	–	[129]
	DU Total			33183	10739	15790	2330	[1350]	2653	[2213]	1617	[1474]
Substructure	BR	EA	--	82	10	–	–	–	–	–	–	–
			DECY	–	1	29	18	–	12	–	12	–
	BR Total			82	11	29	18	–	12	–	12	–
	CO	EA	--	5	–	5	–	–	–	–	–	–
	CO Total			5	–	5	–	–	–	–	–	–
	PC	LF	--	3201	1831	1081	–	–	–	–	–	–
			ABWC	–	–	–	1	–	–	–	–	–
			CRKC	–	–	–	16	–	1	–	–	[1]
			DLSP	–	–	78	84	[16]	41	[22]	5	[6]
			EFRS	–	–	–	–	–	2	–	–	–
			EXPR	–	–	–	13	[63]	22	[18]	11	–
			PTCH	–	–	15	–	–	–	–	–	–
	PC Total			3201	1831	1174	114	[79]	66	[40]	16	[7]
	PI	EA	--	775	441	127	–	–	–	–	–	–
			CHSH	–	–	–	3	–	–	–	–	–
			CORR	–	–	–	1	[4]	–	–	–	–
			CRKC	–	–	–	2	–	2	–	–	–
			DECY	–	–	91	33	–	9	–	26	–
			DLSP	–	–	2	16	–	10	[2]	3	–
			EXPR	–	–	–	–	[6]	1	[1]	1	[1]
			PEEL	–	–	–	–	–	–	–	7	–
	PI Total			775	441	220	55	[10]	22	[3]	37	[1]
	PS	LF	--	736	21	585	–	–	–	–	–	–
			CRKC	–	–	–	4	–	1	–	–	–
			DLSF	–	–	–	–	–	2	–	6	–
			DLSP	–	–	–	12	–	38	[6]	53	[6]
			EFRS	–	–	–	–	–	–	–	–	[12]
			EXPR	–	–	–	–	[13]	–	[20]	11	[32]
			PTCH	–	–	–	3	–	–	–	–	–
	PS Total			736	21	585	19	[13]	41	[26]	70	[50]
	RW	LF	--	314	261	–	–	–	–	–	–	–
			DLSP	–	–	–	–	–	–	[4]	–	–
			EXPR	–	–	–	–	–	–	[4]	–	–
			SCOR	–	–	–	–	–	–	–	53	–
	RW Total			314	261	–	–	–	–	[8]	53	–
	SW	LF	--	920	106	646	–	–	–	–	–	–
			CRKC	–	–	4	21	–	1	–	–	–
			DLSP	–	–	–	63	[8]	29	[34]	–	–
			EFRS	–	–	–	–	[8]	–	–	–	–
			EXPR	–	–	–	5	[27]	41	[27]	–	–

Sample Component Summary Table

Structural Components: Condition State Summary

Component	Element Group	Units	Condition State Code	Total Quantity	Inaccessible	CS1	CS2	CS2 [NC]	CS3	CS3 [NC]	CS4	CS4 [NC]
Substructure	SW	LF	PTCH	–	–	1	3	–	–	–	–	–
	SW Total			**920**	**106**	**651**	**92**	**[43]**	**71**	**[61]**	**–**	**–**
Superstructure	DB	LF	--	6988	1987	2761	–	–	–	–	–	–
			CRKC	–	–	28	74	[28]	46	[1]	19	–
			DLSP	–	–	62	377	[140]	277	[302]	347	[375]
			EFRS	–	–	–	21	[45]	9	[7]	–	–
			EXPR	–	–	–	128	[324]	242	[246]	476	[422]
			PTCH	–	–	16	90	[23]	22	[24]	–	[9]
			WEAR	–	–	6	–	–	–	–	–	–
	DB Total			**6988**	**1987**	**2873**	**690**	**[560]**	**596**	**[580]**	**842**	**[806]**

Sample Component Summary Table

Ancillary Components: Condition State Summary

Component	Element Group	Units	Condition State Code	Total Quantity	Inaccessible	CS1	CS2	CS2 [NC]	CS3	CS3 [NC]	CS4	CS4 [NC]
Personnel Access Sys	HC	EA	--	1	–	–	–	–	–	–	–	–
			CORR	–	–	–	–	–	–	–	1	–
	HC Total			**1**	**–**	**–**	**–**	**–**	**–**	**–**	**1**	**–**
Utilities	UT	LF	--	336	105	82	–	–	–	–	–	–
			ANCI	–	–	–	84	–	–	–	–	–
			CONX	–	–	–	–	–	–	–	2	–
			EROS	–	–	–	–	[21]	–	–	63	–
	UT Total			**336**	**105**	**82**	**84**	**[21]**	**–**	**–**	**65**	**–**

Sample Element Detail Table

Structural Components: Detail Table

Component	ID	Units	Photos	Comments	Condition State Code	Total Quantity	Inaccessible	CS1	CS2	CS2 [NC]	CS3	CS3 [NC]	CS4	CS4 [NC]
Superstructure	**DB 12C-5 Total**					**11**	**11**	**–**	**–**	**–**	**–**	**–**	**–**	**–**
Superstructure	DB 12C-6	LF			--	11	11	–	–	–	–	–	–	–
Superstructure	**DB 12C-6 Total**					**11**	**11**	**–**	**–**	**–**	**–**	**–**	**–**	**–**
Superstructure	DB 12C-7	LF			--	11	11	–	–	–	–	–	–	–
Superstructure	**DB 12C-7 Total**					**11**	**11**	**–**	**–**	**–**	**–**	**–**	**–**	**–**
Superstructure	DB 12C-8	LF			--	14	14	–	–	–	–	–	–	–
Superstructure	**DB 12C-8 Total**					**14**	**14**	**–**	**–**	**–**	**–**	**–**	**–**	**–**
Superstructure	DB 13A-1	LF			--	19	–	17	–	–	–	–	–	–
Superstructure					DLSP	–	–	–	–	–	1	–	–	–
Superstructure					EXPR	–	–	–	–	–	–	[2]	–	–
Superstructure	**DB 13A-1 Total**					**19**	**–**	**17**	**–**	**–**	**1**	**[2]**	**–**	**–**
Superstructure	DB 13A-2	LF			--	19	–	–	–	–	–	–	–	–
Superstructure					EXPR	–	–	–	–	–	–	[19]	–	–
Superstructure			CRJ 160-162	Stirrups exposed along entire sloped fa	DLSP	–	–	–	–	–	1	–	–	–
Superstructure	**DB 13A-2 Total**					**19**	**–**	**–**	**–**	**–**	**1**	**[19]**	**–**	**–**
Superstructure	DB 13A-3	LF			--	19	–	17	–	–	–	–	–	–
Superstructure					DLSP	–	–	–	1	–	–	–	–	–
Superstructure					EXPR	–	–	–	–	[2]	–	–	–	–
Superstructure	**DB 13A-3 Total**					**19**	**–**	**17**	**1**	**[2]**	**–**	**–**	**–**	**–**
Superstructure	DB 13A-4	LF			--	19	–	15	–	–	–	–	–	–
Superstructure					DLSP	–	–	–	1	–	–	–	–	–
Superstructure					EXPR	–	–	–	–	[4]	–	–	–	–
Superstructure	**DB 13A-4 Total**					**19**	**–**	**15**	**1**	**[4]**	**–**	**–**	**–**	**–**
Superstructure	DB 13A-5	LF			--	19	–	3	–	–	–	–	–	–
Superstructure					DLSP	–	–	–	1	–	1	–	–	–
Superstructure					EFRS	–	–	–	1	–	–	–	–	–
Superstructure					EXPR	–	–	–	–	[4]	–	[10]	–	–
Superstructure	**DB 13A-5 Total**					**19**	**–**	**3**	**2**	**[4]**	**1**	**[10]**	**–**	**–**
Superstructure	DB 13A-6	LF			--	19	–	19	–	–	–	–	–	–
Superstructure	**DB 13A-6 Total**					**19**	**–**	**19**	**–**	**–**	**–**	**–**	**–**	**–**
Superstructure	DB 13A-7	LF			--	19	–	19	–	–	–	–	–	–
Superstructure	**DB 13A-7 Total**					**19**	**–**	**19**	**–**	**–**	**–**	**–**	**–**	**–**
Superstructure	DB 13A-8	LF			--	19	–	15	–	–	–	–	–	–
Superstructure					DLSP	–	–	–	1	–	–	–	–	–
Superstructure					EXPR	–	–	–	–	[4]	–	–	–	–
Superstructure	**DB 13A-8 Total**					**19**	**–**	**15**	**1**	**[4]**	**–**	**–**	**–**	**–**
Superstructure	DB 13A-9	LF			--	20	–	20	–	–	–	–	–	–
Superstructure	**DB 13A-9 Total**					**20**	**–**	**20**	**–**	**–**	**–**	**–**	**–**	**–**
Superstructure	DB 13A-10	LF			--	7	–	7	–	–	–	–	–	–
Superstructure	**DB 13A-10 Total**					**7**	**–**	**7**	**–**	**–**	**–**	**–**	**–**	**–**
Superstructure	DB 13A-11	LF			--	19	–	19	–	–	–	–	–	–
Superstructure	**DB 13A-11 Total**					**19**	**–**	**19**	**–**	**–**	**–**	**–**	**–**	**–**
Superstructure	DB 13B-1	LF			--	18	18	–	–	–	–	–	–	–
Superstructure	**DB 13B-1 Total**					**18**	**18**	**–**	**–**	**–**	**–**	**–**	**–**	**–**
Superstructure	DB 13B-2	LF			--	18	18	–	–	–	–	–	–	–
Superstructure	**DB 13B-2 Total**					**18**	**18**	**–**	**–**	**–**	**–**	**–**	**–**	**–**
Superstructure	DB 13B-3	LF			--	18	18	–	–	–	–	–	–	–
Superstructure	**DB 13B-3 Total**					**18**	**18**	**–**	**–**	**–**	**–**	**–**	**–**	**–**
Superstructure	DB 13B-4	LF			--	18	18	–	–	–	–	–	–	–
Superstructure	**DB 13B-4 Total**					**18**	**18**	**–**	**–**	**–**	**–**	**–**	**–**	**–**
Superstructure	DB 13B-5	LF			--	18	18	–	–	–	–	–	–	–
Superstructure	**DB 13B-5 Total**					**18**	**18**	**–**	**–**	**–**	**–**	**–**	**–**	**–**
Superstructure	DB 13B-6	LF			--	18	18	–	–	–	–	–	–	–
Superstructure	**DB 13B-6 Total**					**18**	**18**	**–**	**–**	**–**	**–**	**–**	**–**	**–**
Superstructure	DB 14A-1	LF			--	19	–	8	–	–	–	–	–	–
Superstructure					DLSP	–	–	–	1	–	1	–	–	–
Superstructure					EXPR	–	–	–	–	–	–	[8]	–	–
Superstructure	**DB 14A-1 Total**					**19**	**–**	**8**	**1**	**–**	**1**	**[8]**	**–**	**–**
Superstructure	DB 14A-2	LF			--	19	–	–	–	–	–	–	–	–
Superstructure					CRKC	–	–	–	1	–	–	–	–	–
Superstructure					DLSP	–	–	–	1	–	1	–	–	–
Superstructure					EFRS	–	–	–	–	[1]	–	–	–	–
Superstructure					EXPR	–	–	–	–	–	–	[10]	–	–
Superstructure	**DB 14A-2 Total**					**19**	**–**	**–**	**2**	**[1]**	**1**	**[10]**	**–**	**–**
Superstructure	DB 14A-3	LF			--	19	–	8	–	–	–	–	–	–
Superstructure					EXPR	–	–	–	–	–	–	–	–	[5]
Superstructure			CRJ 146-148	End of beam spalled and rebar corrode	DLSP	–	–	–	1	–	–	–	1	–
Superstructure	**DB 14A-3 Total**					**19**	**–**	**8**	**1**	**–**	**–**	**–**	**1**	**[5]**
Superstructure	DB 14A-4	LF			--	19	–	14	–	–	–	–	–	–
Superstructure					CRKC	–	–	–	1	–	–	–	–	–
Superstructure					DLSP	–	–	–	1	–	–	–	–	–
Superstructure					EXPR	–	–	–	–	[1]	–	–	–	–
Superstructure	**DB 14A-4 Total**					**19**	**–**	**14**	**2**	**[1]**	**–**	**–**	**–**	**–**
Superstructure	DB 14A-5	LF			--	20	–	10	–	–	–	–	–	–
Superstructure					DLSP	–	–	–	1	–	–	–	–	–
Superstructure					EXPR	–	–	–	–	[10]	–	–	–	–
Superstructure	**DB 14A-5 Total**					**20**	**–**	**10**	**1**	**[10]**	**–**	**–**	**–**	**–**
Superstructure	DB 14A-6	LF			--	20	–	20	–	–	–	–	–	–

APPENDIX G – STANDARD INSPECTION DRAWINGS

CONSULTANT:

SEAL:

REPRESENTATIVE DRAWINGS

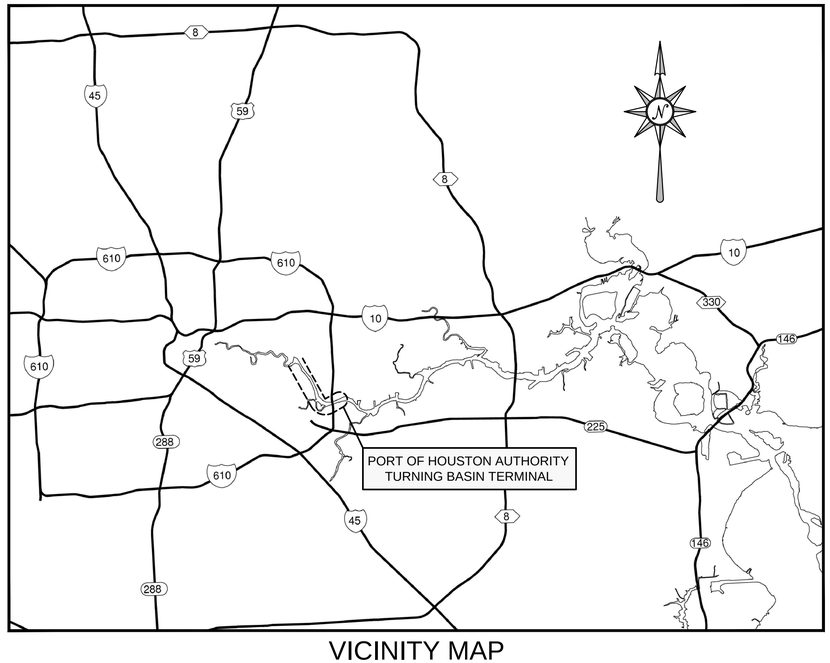
NOT FOR CONSTRUCTION

PORT OF HOUSTON AUTHORITY

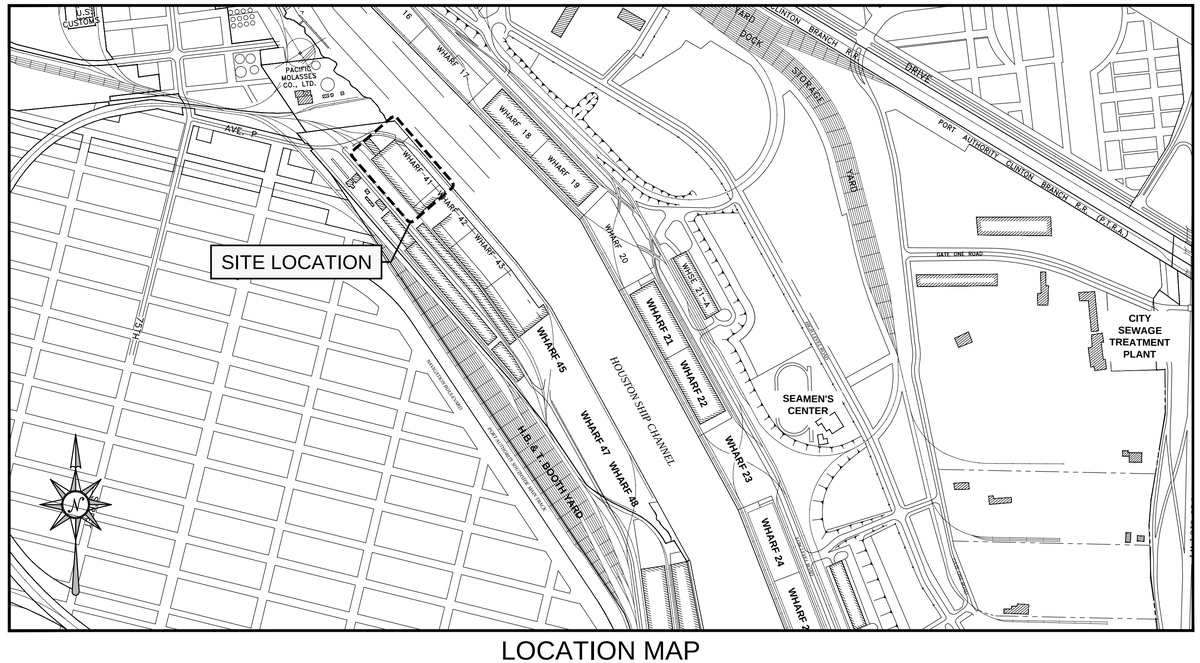
FACILITY INSPECTION & CONDITION ASSESSMENT PROGRAM (FICAP)

BASELINE DRAWINGS FOR WHARF No. 41

DWG NO. XXX-XXX-XXX



VICINITY MAP



LOCATION MAP

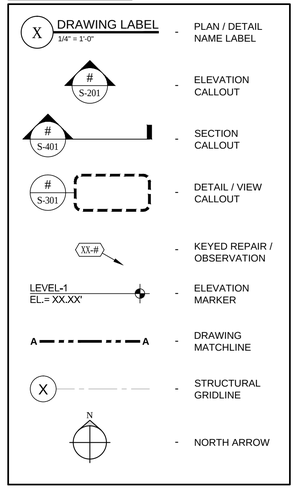
DRAWING No: XXX–XXX–XXX

SHEET No: G–001

REV. No:

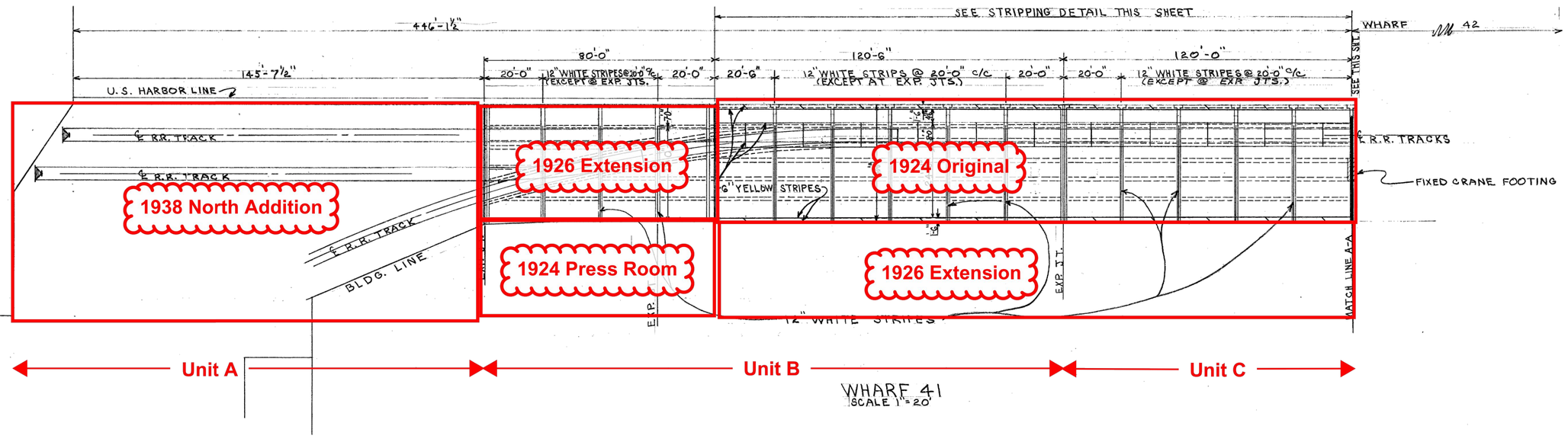
DRAWING SHEET INDEX

SYMBOLS LEGEND



ABBREVIATIONS

&	AND
ADD'L.	ADDITIONAL
ALT.	ALTERNATE
APPROX.	APPROXIMATE
℄	CENTERLINE
C	STEEL CHANNEL SECTION
CJ	CONSTRUCTION JOINT
CONC.	CONCRETE
CONT.	CONTINUOUS
CL	COLUMN
CP	CATHODIC PROTECTION
DB	DECK BEAM
DBL	DECK BEAMLINE
DC	DECK COATING
DIAG.	DIAGONAL
DIA.	DIAMETER
DIM(S).	DIMENSION(S)
DS	DECK SLAB
EA.	EACH
EJ	EXPANSION JOINT
EQ.	EQUAL
EXP.	EXPANSION
FRP	FIBER REINFORCED POLYMER
FS	FENDER STEEL
FT	FENDER TIMBER
GALV.	GALVANIZED
H.S.	HIGH-STRENGTH
HORIZ.	HORIZONTAL
IJ	ISOLATION JOINT
K	KIP (1,000 POUNDS)
LF	LINEAR FEET
MAX.	MAXIMUM
MIN.	MINIMUM
MISC.	MISCELLANEOUS
MLT.	MEAN LOW TIDE
MPH	MILES PER HOUR
No. or #	NUMBER
ℙ	PLATE
PC	PILE CAP
PSF	POUNDS PER SQUARE FOOT
REQ'D.	REQUIRED
RSB	RAIL SWITCH BOX
SB	STRUT BEAM
SBL	STRUT BEAMLINE
SF	SQUARE FEET
SIM.	SIMILAR
SP	SHEET PILE
SW	SHEAR WALL
T.O.	TOP OF .....
TYP.	TYPICAL(LY)
U.N.O.	UNLESS NOTED OTHERWISE
VB	VALVE BOX
VERT.	VERTICAL
V.I.F.	VERIFY IN FIELD
W/	WITH
WP	WORKING POINT



1 KEY PLAN FOR CD 41
SCALE: 1" = 20'-0"

PLOTTED BY: McCready, Leila (2/13/2017 - 3:30 PM)
LAST SAVED BY: LSMRC (2/13/2017 - 3:23 PM)
FILE LOCATION: E:\Port of Houston\Wharf-41 - Representative Drawings

PORT OF HOUSTON AUTHORITY

CONSULTANT:

SEAL:

REPRESENTATIVE DRAWINGS

NOT FOR CONSTRUCTION

PROJECT TITLE:

FACILITY INSPECTION & CONDITION ASSESSMENT PROGRAM (FICAP)

SHEET TITLE:

PROJECT INFORMATION

No.	DATE	DESCRIPTION

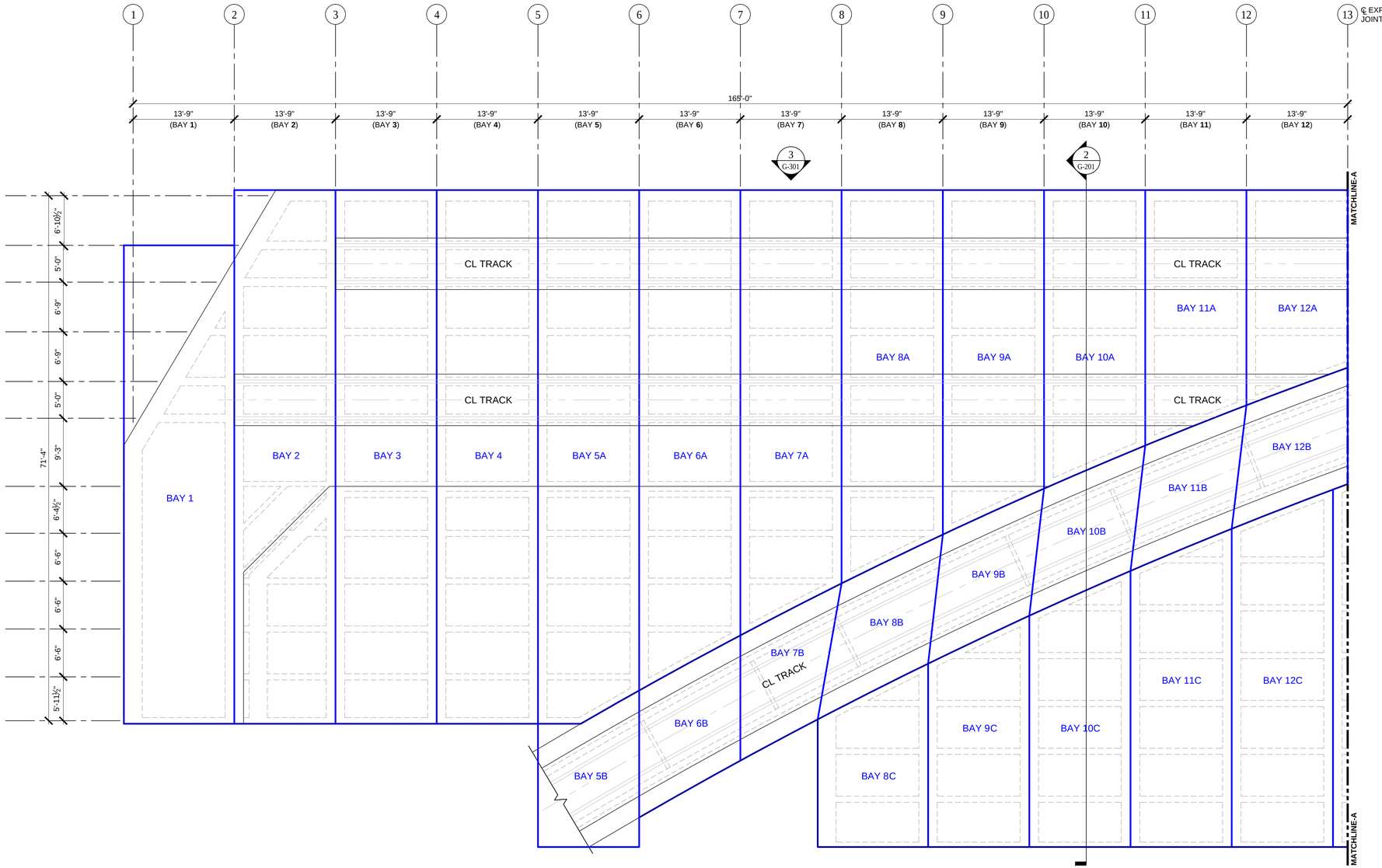
DATE:	10-17-2016
DESIGNER:	JCK
CHECKED BY:	CJL
CADD:	DMC / CLM
SCALE:	AS NOTED

DRAWING No: XXX-XXX-XXX

SHEET No: G-002

REV. No:

SHIP CHANNEL → DOWNSTREAM



LAND SIDE

1 TOPSIDE DECK: BAY PLAN - UNIT-A
1/8" = 1'-0"

PLOTTED BY: McCready, Leslie (3/31/2017 - 3:00 PM)
LAST SAVED BY: LSABIC (3/31/2017 - 3:28 PM)
FILE LOCATION: E:\Port of Houston\Wharf-41 - Representative Drawings

PORT OF HOUSTON AUTHORITY

CONSULTANT:

SEAL:

REPRESENTATIVE DRAWINGS

NOT FOR CONSTRUCTION

PROJECT TITLE:

FACILITY INSPECTION & CONDITION ASSESSMENT PROGRAM (FICAP)

SHEET TITLE:

BASELINE DRAWINGS FOR WHARF No. 41:

UPPER PLAN BAY DEFINITIONS

No.	DATE	DESCRIPTION

DATE:	10-17-2016
DESIGNER:	JCK
CHECKED BY:	CJL
CADD:	DMC / CLM
SCALE:	AS NOTED

DRAWING No: XXX–XXX–XXX

SHEET No: G–101

REV. No:

SHIP CHANNEL → DOWNSTREAM

1 / G-202

13 ℄ EXP. JOINT | 14 | 15 | 16 | 17 ℄ EXP. JOINT | 18 | 19 | 20 | 21 | 22 | 23 ℄ EXP. JOINT

80'-0" | 120'-6"

20'-0" (BAY **13**) | 20'-0" (BAY **14**) | 20'-0" (BAY **15**) | 20'-0" (BAY **16**) | 20'-6" (BAY **17**) | 20'-0" (BAY **18**) | 20'-0" (BAY **19**) | 20'-0" (BAY **20**) | 20'-0" (BAY **21**) | 20'-0" (BAY **22**)

MATCHLINE-A

BAY 13A | BAY 14A | BAY 15A | BAY 16A | BAY 17A | BAY 18A | BAY 19A | BAY 20A | BAY 21A | BAY 22A

MATCHLINE-B

CL TRACK

CL TRACK

7'-1"
7'-0⅜"
6'-11⅞"
5'-11½"
8'-5"
4'-6¾₁₆"
82'-4½"
1'-8⅞₁₆"
20'-2⅜"
20'-6"

BAY 14B

BAY 13B | BAY 14C | BAY 16B | BAY 17B | BAY 17C | BAY 18B | BAY 19B | BAY 20B | BAY 21B | BAY 22B

BAY 14D

MATCHLINE-A

PRESS ROOM

No. 1

MATCHLINE-B

20'-0" | 31'-2" | 28'-10" | 12'-0" | 15'-7⁷⁄₁₆" | 21'-5" | 21'-5⁹⁄₁₆" | 21'-5½" | 21'-5" | 7'-1½"

LAND SIDE

NORTH

1 TOPSIDE DECK: BAY PLAN - UNIT-B
1/8" = 1'-0"

PORT OF HOUSTON AUTHORITY
HOUSTON, TEXAS

PORT OF HOUSTON AUTHORITY

CONSULTANT:

SEAL:

REPRESENTATIVE DRAWINGS
NOT FOR CONSTRUCTION

PROJECT TITLE:

FACILITY INSPECTION & CONDITION ASSESSMENT PROGRAM (FICAP)

SHEET TITLE:

BASELINE DRAWINGS FOR WHARF No. 41:

UPPER PLAN BAY DEFINITIONS

No.	DATE	DESCRIPTION

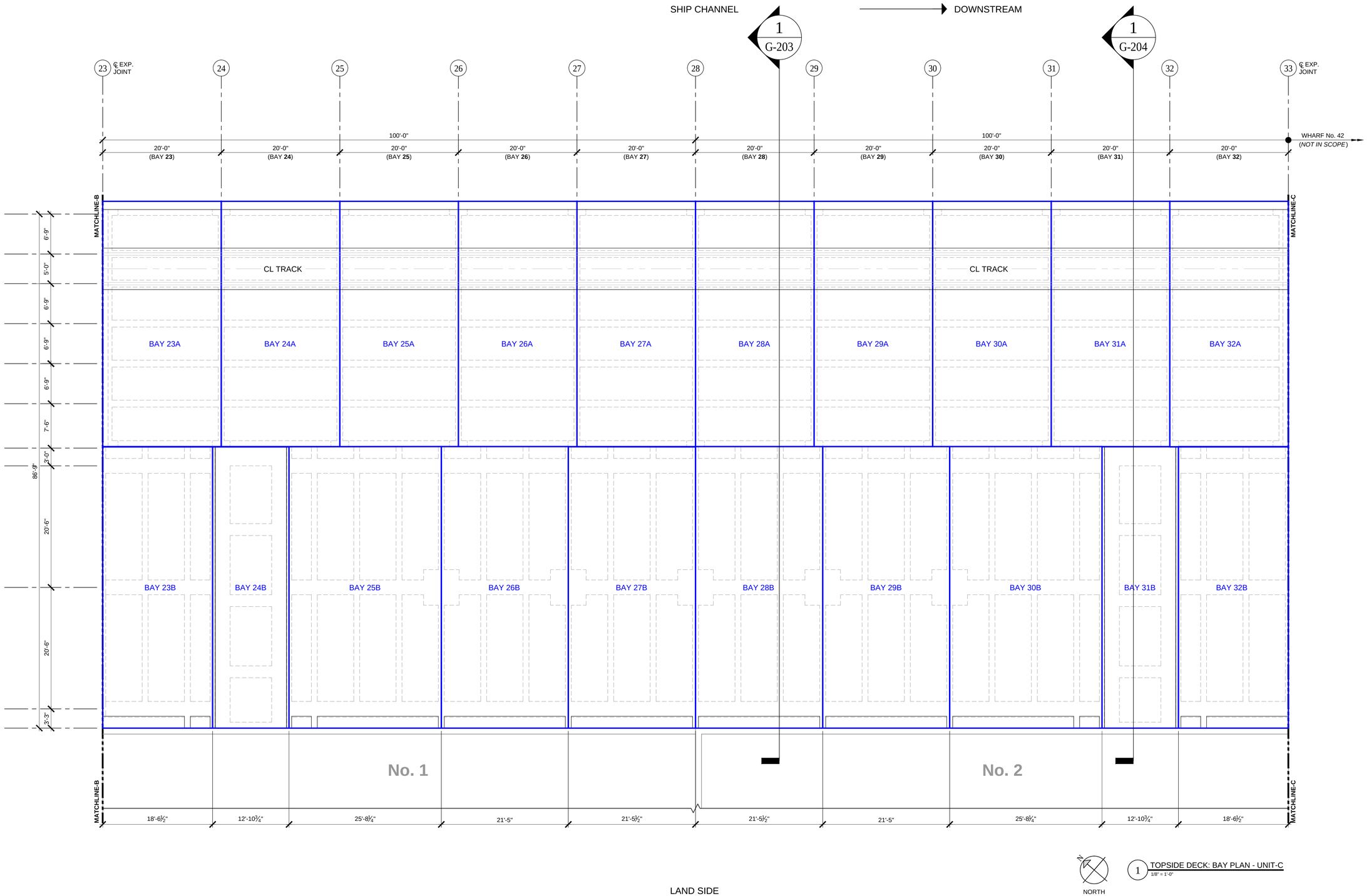
DATE:	10-17-2016
DESIGNER:	JCK
CHECKED BY:	CJL
CADD:	DMC / CLM
SCALE:	AS NOTED

DRAWING No: XXX–XXX–XXX

SHEET No: G–102 | REV. No:

PLOTTED BY: McCready, Leila (3/31/2017 - 3:20 PM)
LAST SAVED BY: LSABC (3/31/2017 - 3:20 PM)
FILE LOCATION: E:\Port of Houston\Wharf 41 - Representative Drawings

SHIP CHANNEL → DOWNSTREAM



LAND SIDE

NORTH

1 TOPSIDE DECK: BAY PLAN - UNIT-C
1/8" = 1'-0"

PORT OF HOUSTON AUTHORITY
HOUSTON, TEXAS

PORT OF HOUSTON AUTHORITY

CONSULTANT:

SEAL:

REPRESENTATIVE DRAWINGS
NOT FOR CONSTRUCTION

PROJECT TITLE:

FACILITY INSPECTION & CONDITION ASSESSMENT PROGRAM (FICAP)

SHEET TITLE:

BASELINE DRAWINGS FOR WHARF No. 41:

UPPER PLAN BAY DEFINITIONS

No.	DATE	DESCRIPTION

DATE:	10-17-2016
DESIGNER:	JCK
CHECKED BY:	CJL
CADD:	DMC / CLM
SCALE:	AS NOTED

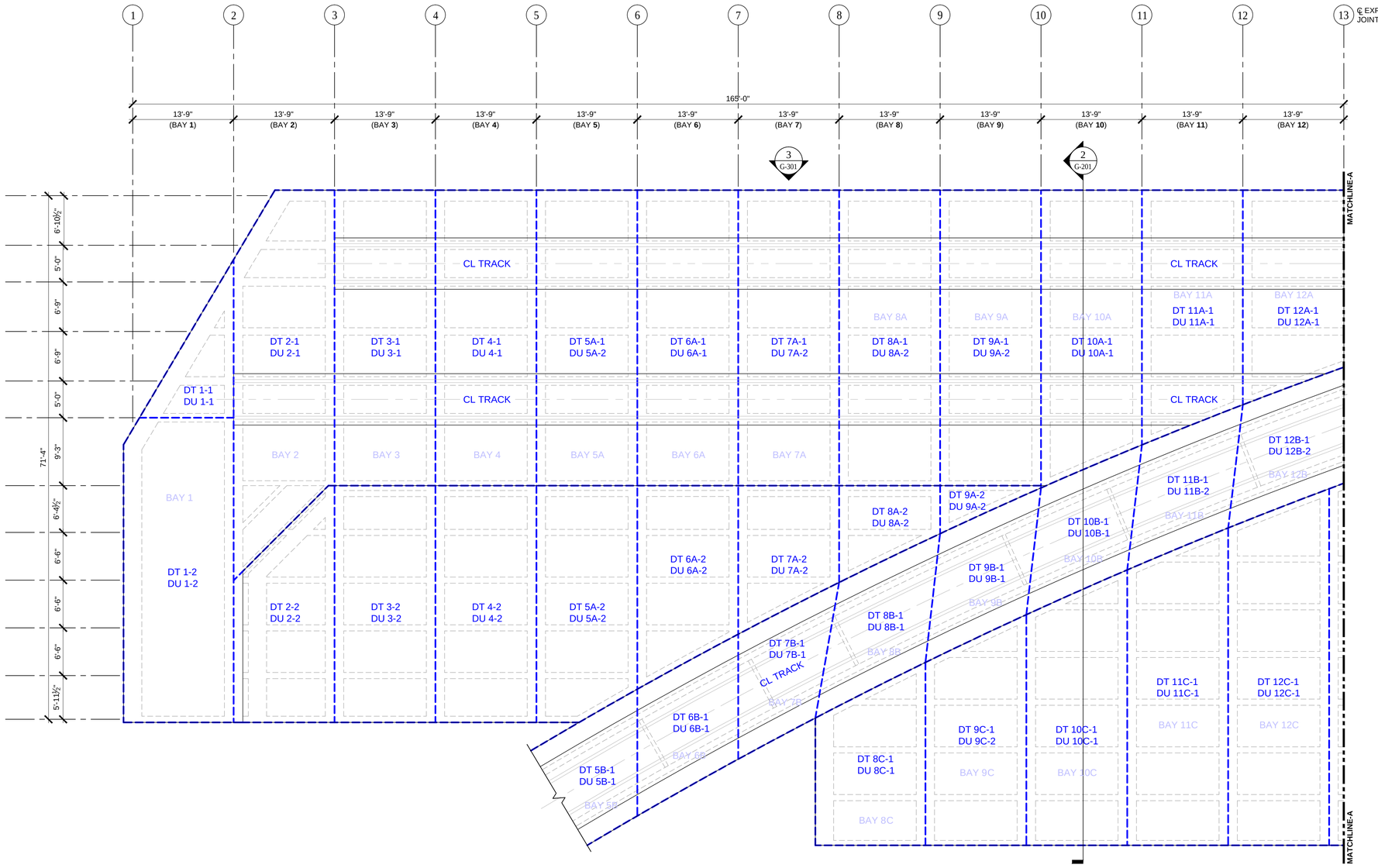
DRAWING No: XXX–XXX–XXX

SHEET No: G–103

REV. No:

PLOTTED BY: McCready, Leila (3/31/2017 - 3:21 PM)
LAST SAVED BY: LSABC (3/31/2017 - 3:20 PM)
FILE LOCATION: E:\Port of Houston\Wharf 41 - Representative Drawings

SHIP CHANNEL → DOWNSTREAM



LAND SIDE

N
NORTH

1 TOPSIDE DECK: ELEMENT PLAN - UNIT-A
1/8" = 1'-0"

PORT OF HOUSTON AUTHORITY

CONSULTANT:

SEAL:

REPRESENTATIVE DRAWINGS
NOT FOR CONSTRUCTION

PROJECT TITLE:

FACILITY INSPECTION & CONDITION ASSESSMENT PROGRAM (FICAP)

SHEET TITLE:

BASELINE DRAWINGS FOR WHARF No. 41:

UPPER PLAN DECK ELEMENTS - UNIT A

No.	DATE	DESCRIPTION

DATE:	10-17-2016
DESIGNER:	JCK
CHECKED BY:	CJL
CADD:	DMC / CLM
SCALE:	AS NOTED

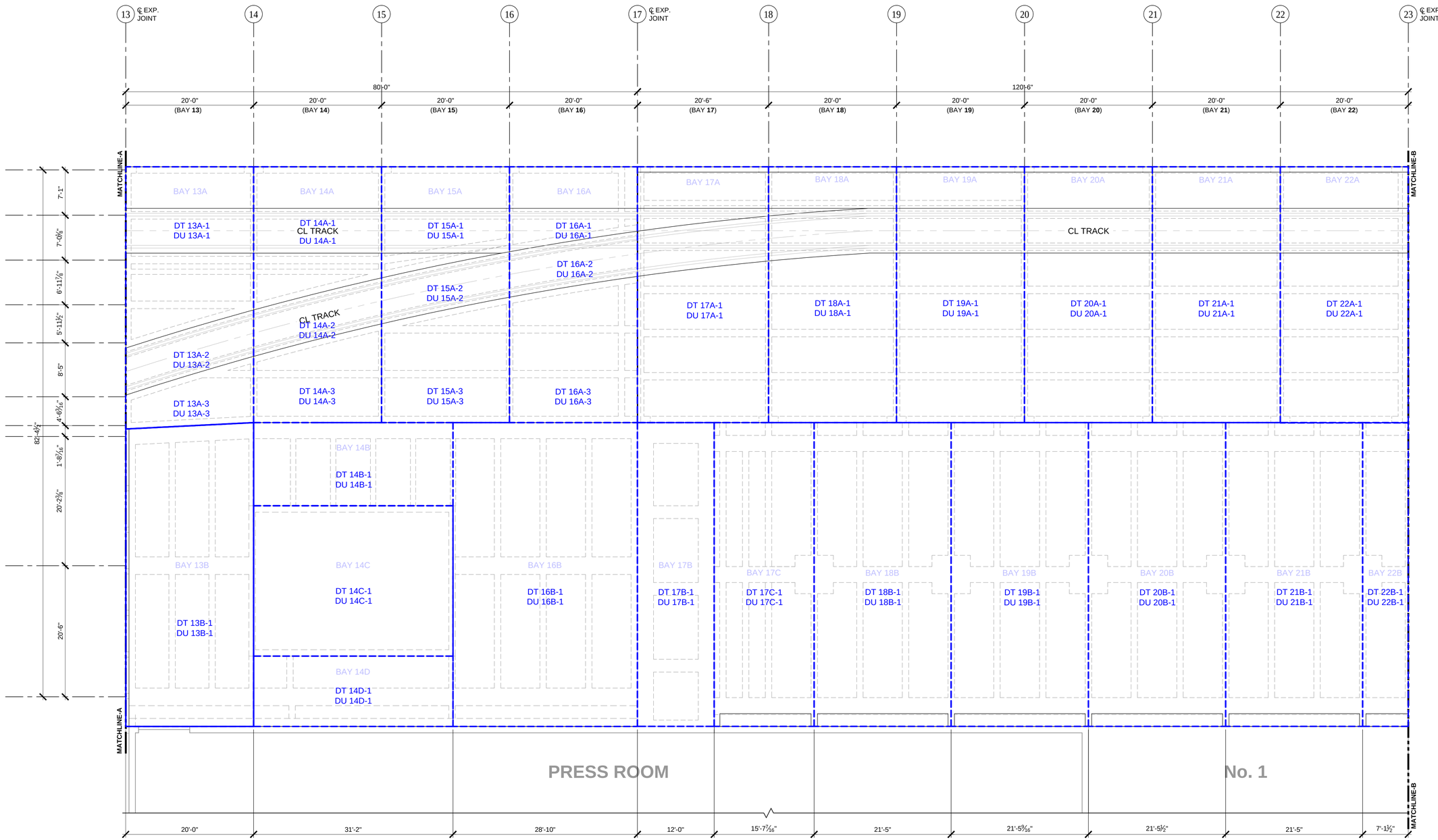
DRAWING No: XXX–XXX–XXX

SHEET No: G–111

REV. No:

PLOTTED BY: McCready, Leila (3/31/2017 - 3:31 PM)
LAST SAVED BY: LSABC (3/31/2017 - 3:28 PM)
FILE LOCATION: E:\Port of Houston\Wharf 41 - Representative Drawings

SHIP CHANNEL → DOWNSTREAM



LAND SIDE

NORTH

1 TOPSIDE DECK: ELEMENT PLAN - UNIT-B
1/8" = 1'-0"

PORT OF HOUSTON AUTHORITY
HOUSTON, TEXAS

PORT OF HOUSTON AUTHORITY

CONSULTANT:

SEAL:

REPRESENTATIVE DRAWINGS
NOT FOR CONSTRUCTION

PROJECT TITLE:

FACILITY INSPECTION & CONDITION ASSESSMENT PROGRAM (FICAP)

SHEET TITLE:

BASELINE DRAWINGS FOR WHARF No. 41:

UPPER PLAN DECK ELEMENTS - UNIT B

No.	DATE	DESCRIPTION

DATE:	10-17-2016
DESIGNER:	JCK
CHECKED BY:	CJL
CADD:	DMC / CLM
SCALE:	AS NOTED

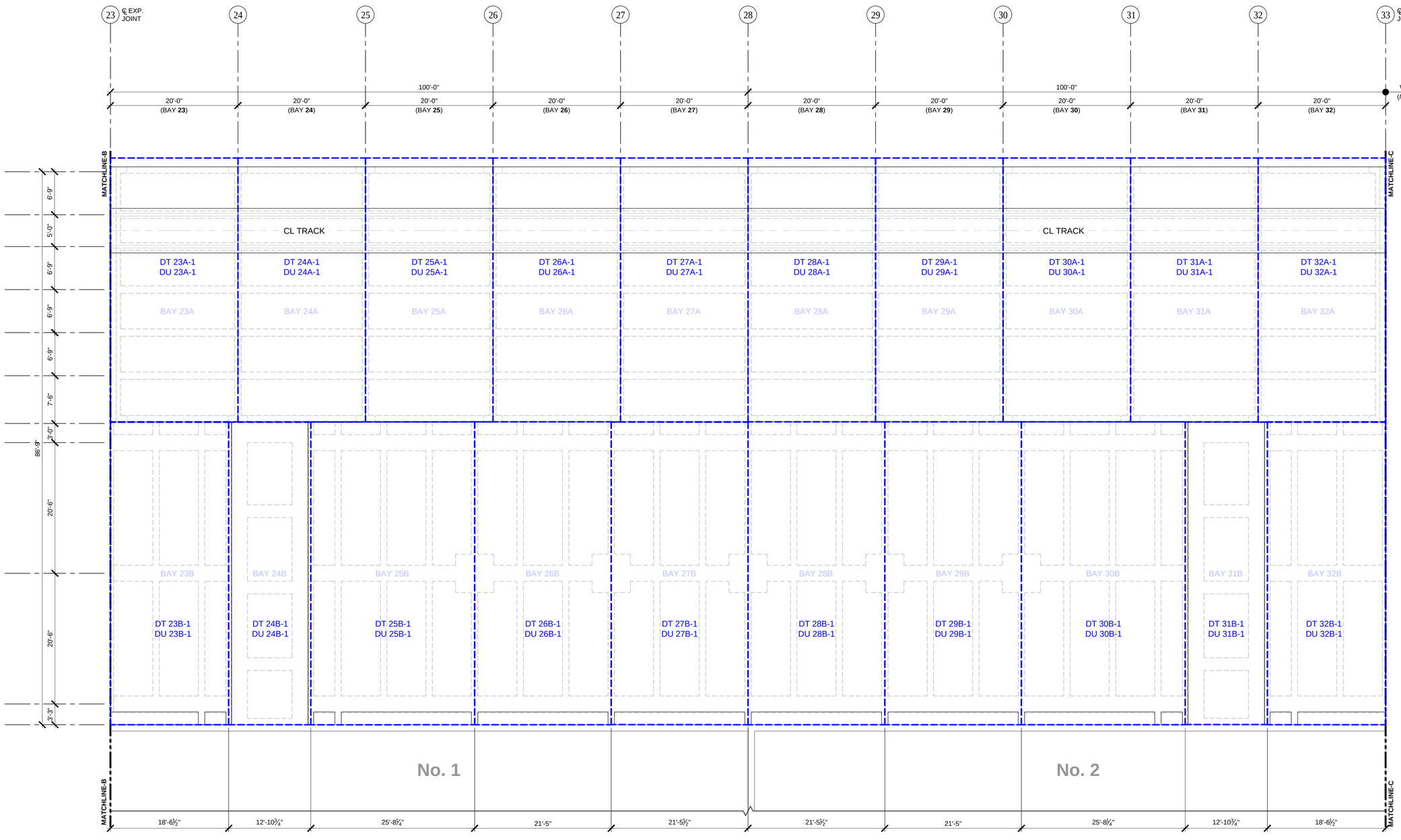
DRAWING No: XXX–XXX–XXX

SHEET No: G–112

REV. No:

PLOTTED BY: McCreath, Leis (3/31/2017 - 2:31 PM)
LAST SAVED BY: LSAMC (3/31/2017 - 3:28 PM)
FILE LOCATION: E:\Port of Houston\Wharf-41 - Representative Drawings

SHIP CHANNEL → DOWNSTREAM



LAND SIDE

NORTH

1 TOPSIDE DECK: ELEMENT PLAN - UNIT-C
1/8" = 1'-0"

PORT OF HOUSTON AUTHORITY
HOUSTON, TEXAS

PORT OF HOUSTON AUTHORITY

CONSULTANT:

SEAL:

REPRESENTATIVE DRAWINGS
NOT FOR CONSTRUCTION

PROJECT TITLE:

FACILITY INSPECTION & CONDITION ASSESSMENT PROGRAM (FICAP)

SHEET TITLE:

BASELINE DRAWINGS FOR WHARF No. 41:

UPPER PLAN DECK ELEMENTS - UNIT C

No.	DATE	DESCRIPTION

DATE:	10-17-2016
DESIGNER:	JCK
CHECKED BY:	CJL
CADD:	DMC / CLM
SCALE:	AS NOTED

DRAWING No: XXX–XXX–XXX

SHEET No: G–113

REV. No:

PLOTTED BY: McCreedy, Leila (3/23/2017 - 2:21 PM)
LAST SAVED BY: LSMIC (3/13/2017 - 3:28 PM)
FILE LOCATION: E:\Port of Houston\Wharf-41 - Representative Drawings

SHIP CHANNEL → DOWNSTREAM

1 TOPSIDE DECK: ELEMENT PLAN - UNIT-A
1/8" = 1'-0"

PORT OF HOUSTON AUTHORITY
HOUSTON, TEXAS

PORT OF HOUSTON AUTHORITY

CONSULTANT:

SEAL:

REPRESENTATIVE DRAWINGS
NOT FOR CONSTRUCTION

PROJECT TITLE:

FACILITY INSPECTION & CONDITION ASSESSMENT PROGRAM (FICAP)

SHEET TITLE:

BASELINE DRAWINGS FOR WHARF No. 41:

UPPER PLAN SUPERSTRUCTURE ELEMENTS - UNIT A

No.	DATE	DESCRIPTION

DATE:	10-17-2016
DESIGNER:	JCK
CHECKED BY:	CJL
CADD:	DMC / CLM
SCALE:	AS NOTED

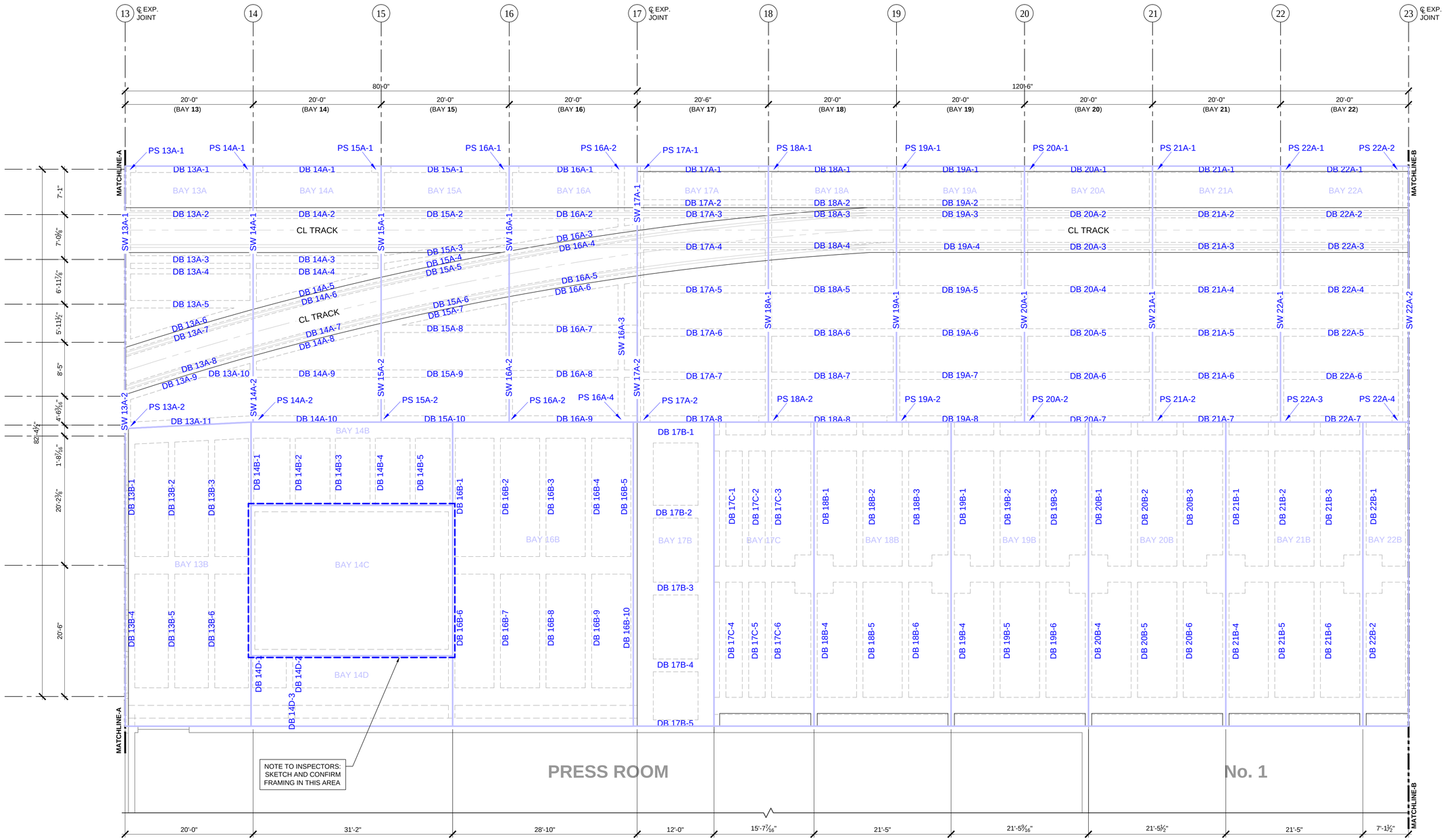
DRAWING No: XXX–XXX–XXX

SHEET No: G–121

REV. No:

PLOTTED BY: McCreedy, Leah (3/31/2017 - 3:21 PM)
LAST SAVED BY: LSARC (3/31/2017 - 3:28 PM)
FILE LOCATION: E:\Port of Houston\Wharf-41 - Representative Drawings

SHIP CHANNEL → DOWNSTREAM



NORTH

1 TOPSIDE DECK: ELEMENT PLAN - UNIT-B
1/8" = 1'-0"

LAND SIDE

PORT OF HOUSTON AUTHORITY
HOUSTON, TEXAS

PORT OF HOUSTON AUTHORITY

CONSULTANT:

SEAL:

REPRESENTATIVE DRAWINGS
NOT FOR CONSTRUCTION

PROJECT TITLE:

FACILITY INSPECTION & CONDITION ASSESSMENT PROGRAM (FICAP)

SHEET TITLE:

BASELINE DRAWINGS FOR WHARF No. 41:

UPPER PLAN SUPERSTRUCTURE ELEMENTS - UNIT B

No.	DATE	DESCRIPTION

DATE:	10-17-2016
DESIGNER:	JCK
CHECKED BY:	CJL
CADD:	DMC / CLM
SCALE:	AS NOTED

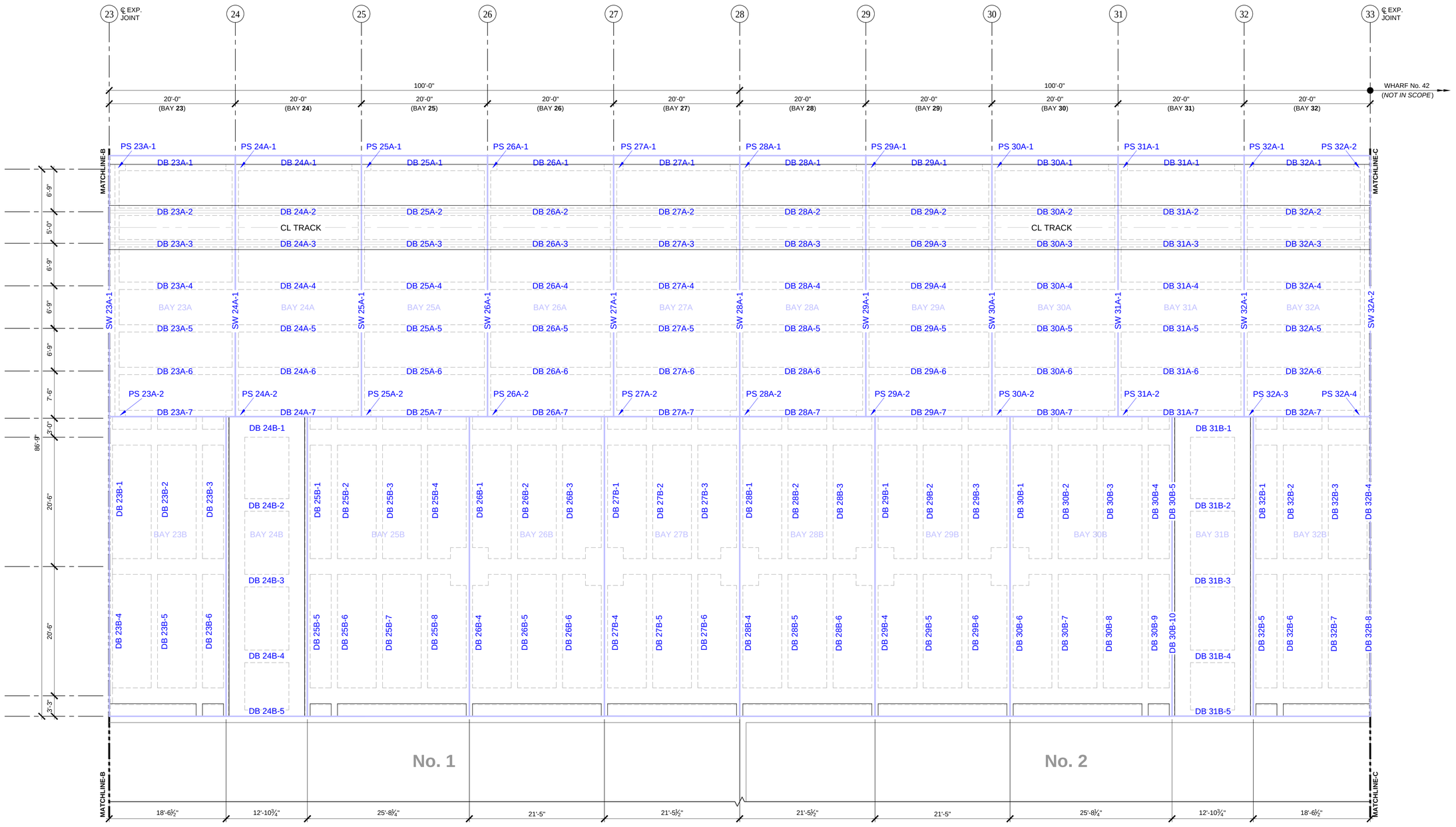
DRAWING No: XXX–XXX–XXX

SHEET No: G–122

REV. No:

PLOTTED BY: McCready, Leila (2/3/2017 - 2:21 PM)
LAST SAVED BY: LSMRC (2/3/2017 - 2:28 PM)
FILE LOCATION: E:\Port of Houston\Wharf-41 - Representative Drawings

SHIP CHANNEL → DOWNSTREAM



LAND SIDE

NORTH

1 TOPSIDE DECK: ELEMENT PLAN - UNIT-C
1/8" = 1'-0"

PORT OF HOUSTON AUTHORITY
HOUSTON, TEXAS

PORT OF HOUSTON AUTHORITY

CONSULTANT:

SEAL:

REPRESENTATIVE DRAWINGS
NOT FOR CONSTRUCTION

PROJECT TITLE:

FACILITY INSPECTION & CONDITION ASSESSMENT PROGRAM (FICAP)

SHEET TITLE:

BASELINE DRAWINGS FOR WHARF No. 41:

UPPER PLAN SUPERSTRUCTURE ELEMENTS - UNIT C

No.	DATE	DESCRIPTION

DATE:	10-17-2016
DESIGNER:	JCK
CHECKED BY:	CJL
CADD:	DMC / CLM
SCALE:	AS NOTED

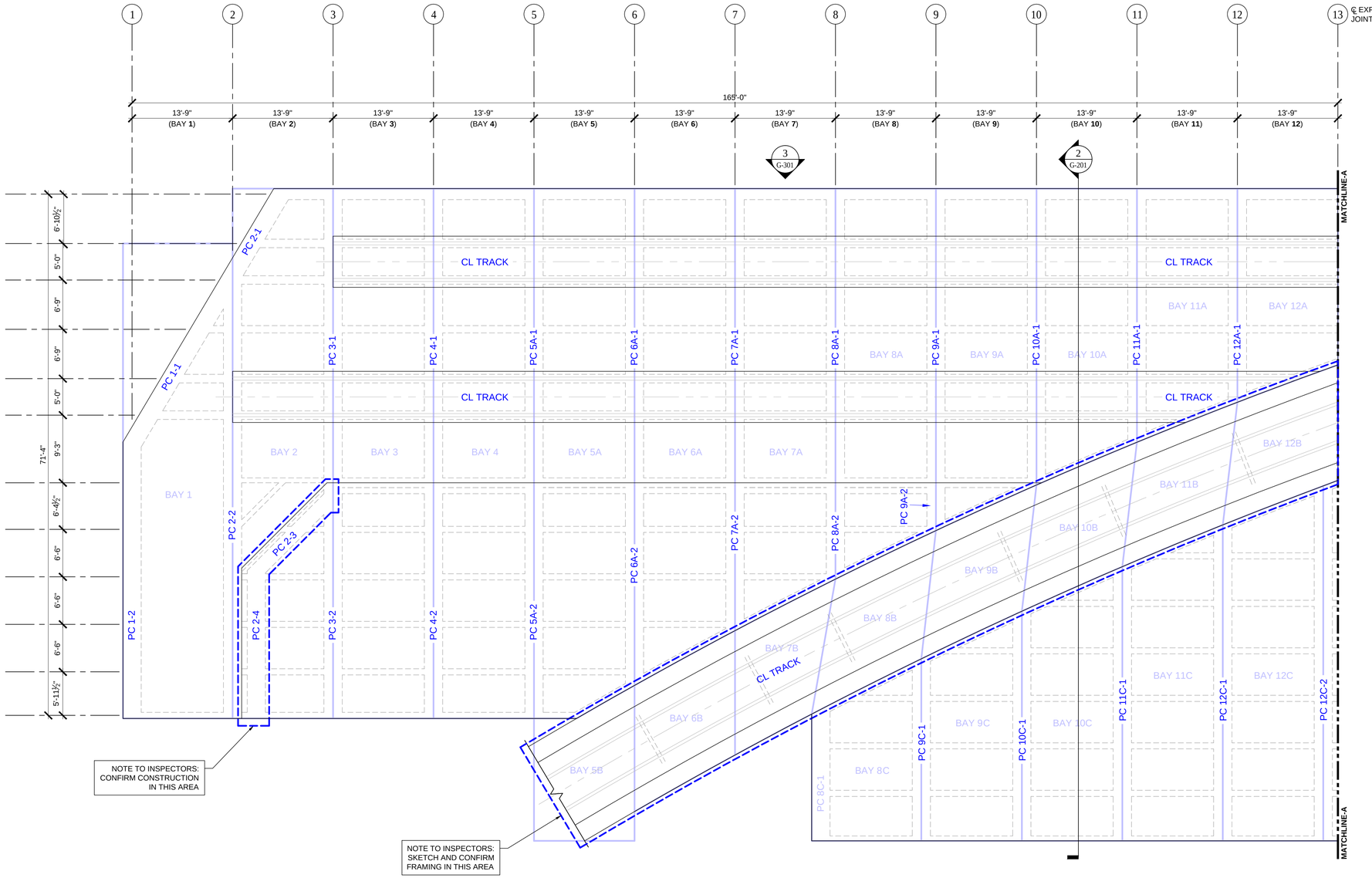
DRAWING No: XXX–XXX–XXX

SHEET No: G–123

REV. No:

PLOTTED BY: McCreedy, Leila (3/31/2017 - 3:31 PM)
LAST SAVED BY: LSAIRC (3/31/2017 - 5:28 PM)
FILE LOCATION: E:\Port of Houston\Wharf-41 - Representative Drawings

SHIP CHANNEL → DOWNSTREAM



LAND SIDE

1 TOPSIDE DECK: ELEMENT PLAN - UNIT-A
1/8" = 1'-0"

PORT OF HOUSTON AUTHORITY

CONSULTANT:

SEAL:

REPRESENTATIVE DRAWINGS

NOT FOR CONSTRUCTION

PROJECT TITLE:

FACILITY INSPECTION & CONDITION ASSESSMENT PROGRAM (FICAP)

SHEET TITLE:

BASELINE DRAWINGS FOR WHARF No. 41:

UPPER PLAN SUBSTRUCTURE ELEMENTS - UNIT A

No.	DATE	DESCRIPTION

DATE:	10-17-2016
DESIGNER:	JCK
CHECKED BY:	CJL
CADD:	DMC / CLM
SCALE:	AS NOTED

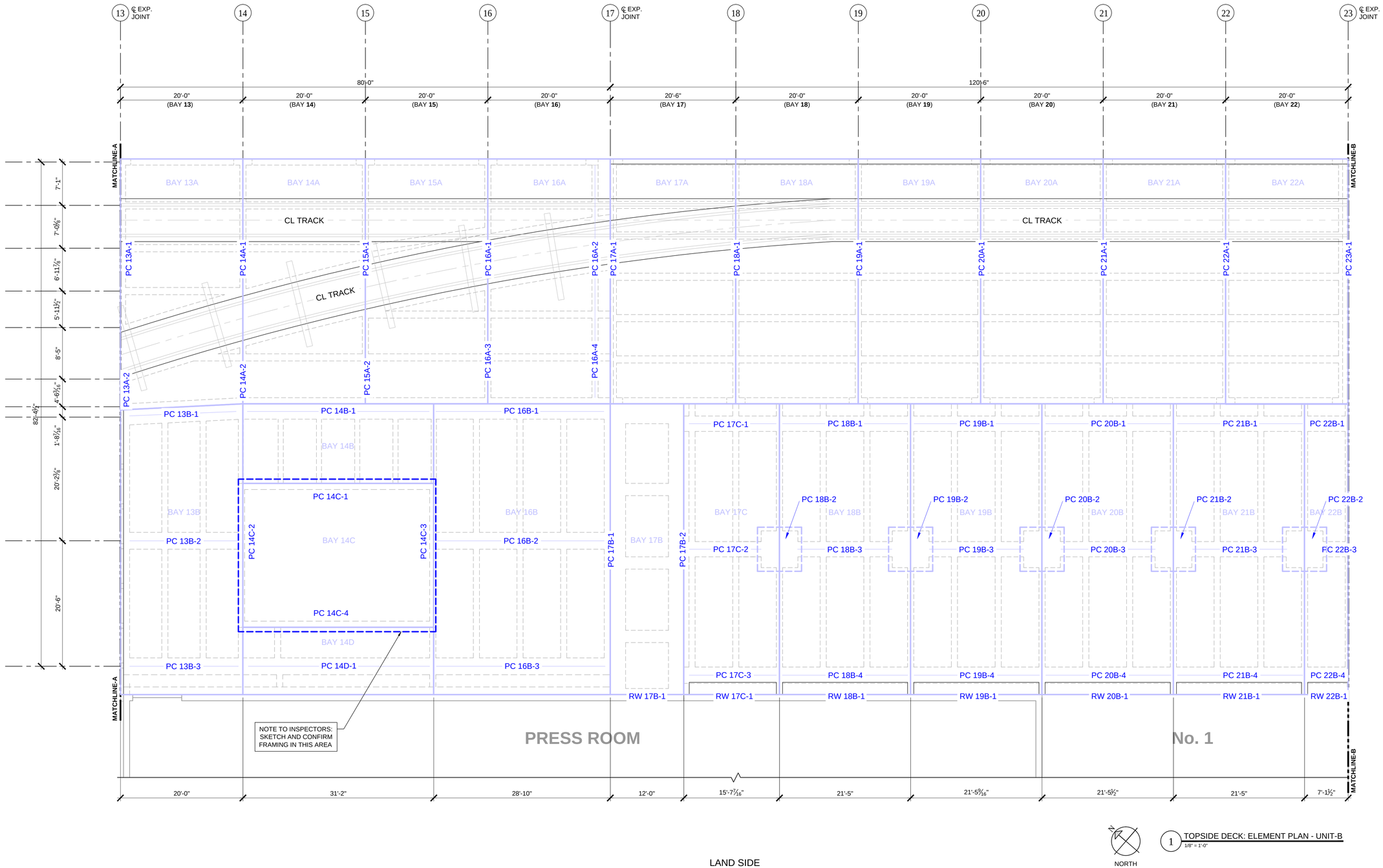
DRAWING No: XXX–XXX–XXX

SHEET No: G–131

REV. No:

PLOTTED BY: McGrath, Lela (3/31/2017 - 3:31 PM)
LAST SAVED BY: LSARC (3/31/2017 - 3:28 PM)
FILE LOCATION: E:\Port of Houston\Wharf 41 - Representative Drawings

SHIP CHANNEL → DOWNSTREAM



LAND SIDE

NORTH

1 TOPSIDE DECK: ELEMENT PLAN - UNIT-B
1/8" = 1'-0"

PORT OF HOUSTON AUTHORITY
HOUSTON, TEXAS

PORT OF HOUSTON AUTHORITY

CONSULTANT:

SEAL:

REPRESENTATIVE DRAWINGS
NOT FOR CONSTRUCTION

PROJECT TITLE:

FACILITY INSPECTION & CONDITION ASSESSMENT PROGRAM (FICAP)

SHEET TITLE:

BASELINE DRAWINGS FOR WHARF No. 41:

UPPER PLAN SUBSTRUCTURE ELEMENTS - UNIT B

No.	DATE	DESCRIPTION

DATE:	10-17-2016
DESIGNER:	JCK
CHECKED BY:	CJL
CADD:	DMC / CLM
SCALE:	AS NOTED

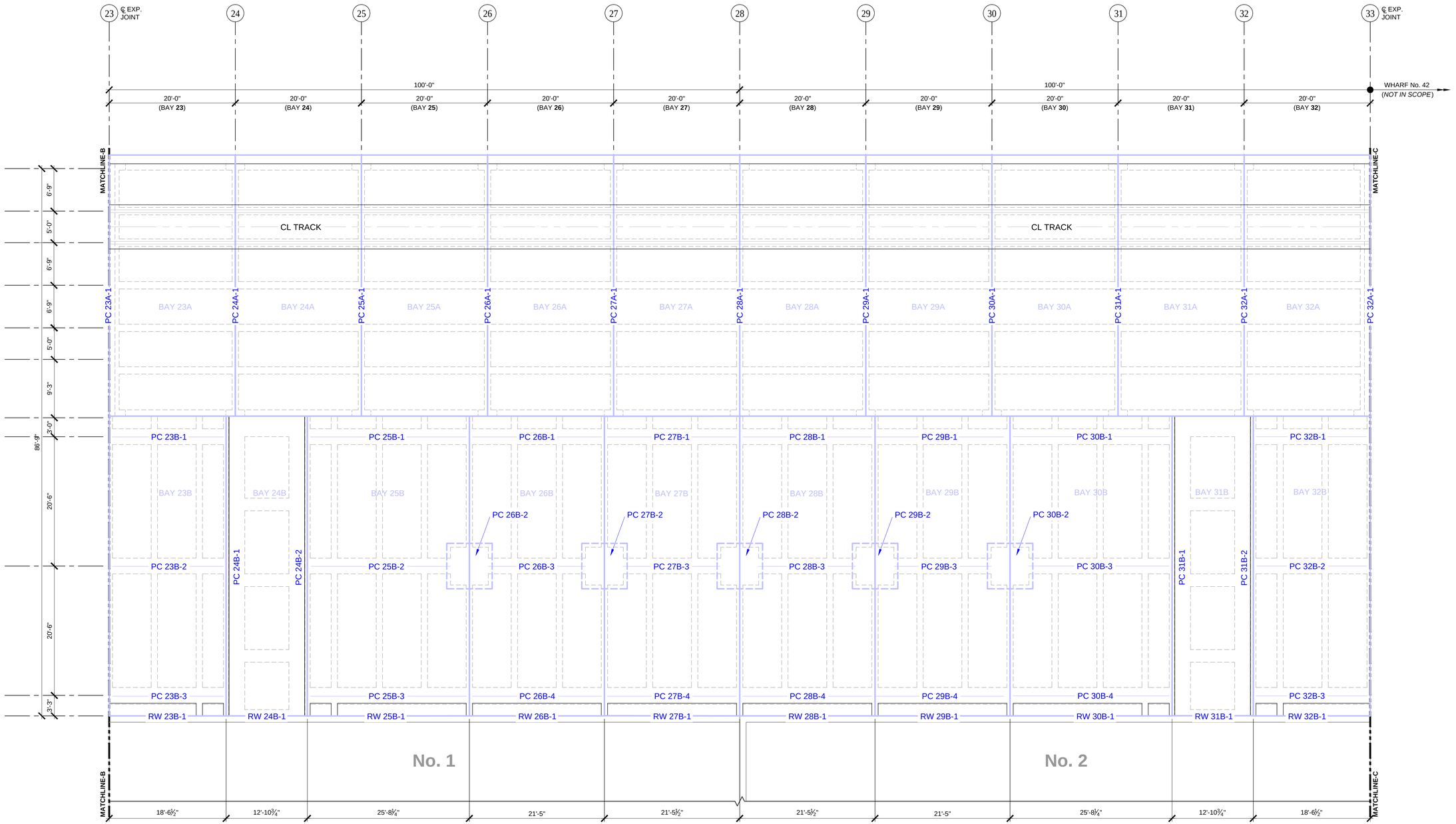
DRAWING No: XXX–XXX–XXX

SHEET No: G–132

REV. No:

PLOTTED BY: McCready, Lela (3/31/2017 - 3:31 PM)
LAST SAVED BY: LSARC (3/31/2017 - 3:28 PM)
FILE LOCATION: E:\Port of Houston\Wharf 41 - Representative Drawings

SHIP CHANNEL → DOWNSTREAM



LAND SIDE

NORTH

1 TOPSIDE DECK: ELEMENT PLAN - UNIT-C
1/8" = 1'-0"

PORT OF HOUSTON AUTHORITY
HOUSTON, TEXAS

PORT OF HOUSTON AUTHORITY

CONSULTANT:

SEAL:

REPRESENTATIVE DRAWINGS
NOT FOR CONSTRUCTION

PROJECT TITLE:

FACILITY INSPECTION & CONDITION ASSESSMENT PROGRAM (FICAP)

SHEET TITLE:

BASELINE DRAWINGS FOR WHARF No. 41:

UPPER PLAN SUBSTRUCTURE ELEMENTS - UNIT C

No.	DATE	DESCRIPTION

DATE:	10-17-2016
DESIGNER:	JCK
CHECKED BY:	CJL
CADD:	DMC / CLM
SCALE:	AS NOTED

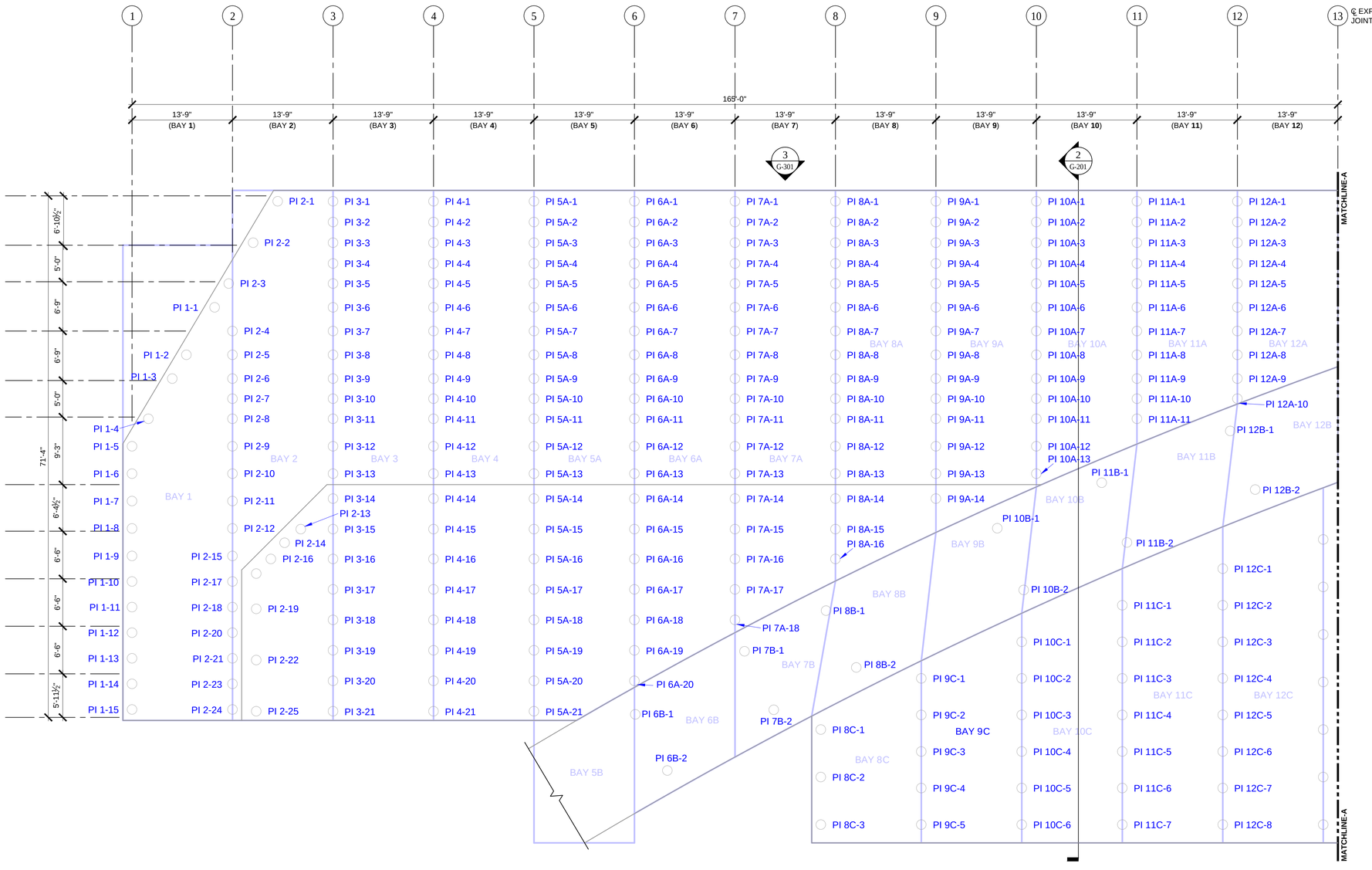
DRAWING No: XXX–XXX–XXX

SHEET No: G–133

REV. No:

PLOTTED BY: McCready, Leila (3/31/2017 - 3:21 PM)
LAST SAVED BY: LSARC (3/31/2017 - 3:28 PM)
FILE LOCATION: E:\Port of Houston\Wharf 41 - Representative Drawings

SHIP CHANNEL → DOWNSTREAM



1 SUPERSTRUCTURE: DECK UNDERSIDE PLAN - UNIT-A
1/8" = 1'-0"

PORT OF HOUSTON AUTHORITY
HOUSTON, TEXAS

PORT OF HOUSTON AUTHORITY

CONSULTANT:

SEAL:

REPRESENTATIVE DRAWINGS
NOT FOR CONSTRUCTION

PROJECT TITLE:

FACILITY INSPECTION & CONDITION ASSESSMENT PROGRAM (FICAP)

SHEET TITLE:

BASELINE DRAWINGS FOR WHARF No. 41:

LOWER PLAN PILE AND BULKHEAD ELEMENTS - UNIT A

No.	DATE	DESCRIPTION

DATE:	10-17-2016
DESIGNER:	JCK
CHECKED BY:	CJL
CADD:	DMC / CLM
SCALE:	AS NOTED

DRAWING No: XXX–XXX–XXX

SHEET No: G–141

REV. No:

PLOTTED BY: McCreedy, Leah (2/3/2017 - 2:21 PM)
LAST SAVED BY: LSMIC (2/3/2017 - 2:28 PM)
FILE LOCATION: E:\Port of Houston\Wharf-41 - Representative Drawings

SHIP CHANNEL → DOWNSTREAM

13 ℄ EXP. JOINT | 14 | 15 | 16 | 17 ℄ EXP. JOINT | 18 | 19 | 20 | 21 | 22 | 23 ℄ EXP. JOINT

80'-0" | 120'-6"

20'-0" (BAY 13) | 20'-0" (BAY 14) | 20'-0" (BAY 15) | 20'-0" (BAY 16) | 20'-6" (BAY 17) | 20'-0" (BAY 18) | 20'-0" (BAY 19) | 20'-0" (BAY 20) | 20'-0" (BAY 21) | 20'-0" (BAY 22)

MATCHLINE-A

PI 13A-1 PI 13A-2 PI 13A-3 PI 13A-4 PI 13A-5 PI 13A-6 PI 13A-7 PI 13A-8 PI 13A-9 PI 13A-10 PI 13A-11

PI 14A-1 PI 14A-2 PI 14A-3 PI 14A-4 PI 14A-5 PI 14A-6 PI 14A-7 PI 14A-8 PI 14A-9 PI 14A-10 PI 14A-11

PI 15A-1 PI 15A-2 PI 15A-3 PI 15A-4 PI 15A-5 PI 15A-6 PI 15A-7 PI 15A-8 PI 15A-9 PI 15A-10 PI 15A-11

PI 16A-1 PI 16A-2 PI 16A-3 PI 16A-4 PI 16A-5 PI 16A-6 PI 16A-7 PI 16A-8 PI 16A-9 PI 16A-10 PI 16A-11

PI 16A-12 PI 16A-13 PI 16A-14 PI 16A-15 PI 16A-16 PI 16A-17 PI 16A-18

PI 17A-1 PI 17A-2 PI 17A-3 PI 17A-4 PI 17A-5 PI 17A-6 PI 17A-7 PI 17A-8 PI 17A-9 PI 17A-10 PI 17A-11 PI 17A-12 PI 17A-13

PI 18A-1 PI 18A-2 PI 18A-3 PI 18A-4 PI 18A-5 PI 18A-6 PI 18A-7 PI 18A-8 PI 18A-9 PI 18A-10 PI 18A-11 PI 18A-12 PI 18A-13

PI 19A-1 PI 19A-2 PI 19A-3 PI 19A-4 PI 19A-5 PI 19A-6 PI 19A-7 PI 19A-8 PI 19A-9 PI 19A-10 PI 19A-11 PI 19A-12 PI 19A-13

PI 20A-1 PI 20A-2 PI 20A-3 PI 20A-4 PI 20A-5 PI 20A-6 PI 20A-7 PI 20A-8 PI 20A-9 PI 20A-10 PI 20A-11 PI 20A-12 PI 20A-13

PI 21A-1 PI 21A-2 PI 21A-3 PI 21A-4 PI 21A-5 PI 21A-6 PI 21A-7 PI 21A-8 PI 21A-9 PI 21A-10 PI 21A-11 PI 21A-12 PI 21A-13

PI 22A-1 PI 22A-2 PI 22A-3 PI 22A-4 PI 22A-5 PI 17A-6 PI 22A-7 PI 22A-8 PI 22A-9 PI 22A-10 PI 22A-11 PI 22A-12 PI 22A-13

MATCHLINE-B

PI 23A-1 PI 23A-2 PI 23A-4 PI 23A-6 PI 23A-8 PI 23A-10 PI 23A-12

BAY 13A | BAY 14A | BAY 15A | BAY 16A | BAY 17A | BAY 18A | BAY 19A | BAY 20A | BAY 21A | BAY 22A

7'-1" | 7'-0⅝" | 6'-11⅞" | 5'-11½" | 8'-5" | 4'-6⅝" | 82'-4½" | 1'-8⅛" | 20'-2⅝" | 20'-6"

PF 13B-5

PF 13B-1 PF 13B-2 PF 13B-3 PF 13B-4

BAY 14B

PF 14C-1 PF 14C-2 PF 14C-3

PF 13B-7 PF 13B-8 PF 13B-9 PF 13B-10

BAY 13B | BAY 14C | BAY 16B

PF 13B-6

PF 13B-12 PF 13B-13 PF 13B-15

BAY 14D

PF 13B-11 PF 13B-14

PI 17B-1 PI 17B-2 PI 17B-3 PI 17B-4 PI 17B-5 PI 17B-6 PI 17B-7 PI 17B-8 PI 17B-10 PI 17B-9

BAY 17B

PI 17C-1 PI 17C-2 PI 17C-3 PI 17C-4 PI 17C-5 PI 17C-6 PI 17C-7 PI 17C-8 PI 17C-9 PI 17C-10

BAY 17C

PI 18B-1 PI 18B-2 PI 18B-3 PI 18B-4 PI 18B-5 PI 18B-6 CO 18B-1 PI 18B-7 PI 18B-8 PI 18B-9 PI 18B-10 PI 18B-11 PI 18B-12 PI 18B-13 PI 18B-14 PI 18B-15 PI 18B-16 PI 18B-17

BAY 18B

PI 19B-1 PI 19B-2 PI 19B-3 PI 19B-4 PI 19B-5 PI 19B-6 CO 19B-1 PI 19B-7 PI 19B-8 PI 19B-9 PI 19B-10 PI 19B-11 PI 19B-12 PI 19B-13 PI 19B-14 PI 19B-15 PI 19B-16 PI 19B-17

BAY 19B

PI 20B-1 PI 20B-2 PI 20B-3 PI 20B-4 PI 20B-5 PI 20B-6 CO 20B-1 PI 20B-7 PI 20B-8 PI 20B-9 PI 20B-10 PI 20B-11 PI 20B-12 PI 20B-13 PI 20B-14 PI 20B-15 PI 20B-16 PI 20B-17

BAY 20B

PI 21B-1 PI 21B-2 PI 21B-3 PI 21B-4 PI 21B-5 PI 21B-6 CO 21B-1 PI 21B-7 PI 21B-8 PI 21B-9 PI 21B-10 PI 21B-11 PI 21B-12 PI 21B-13 PI 21B-14 PI 21B-15 PI 21B-16 PI 21B-17

BAY 21B

PI 22B-1 PI 22B-2 PI 22B-3 PI 22B-4 PI 22B-5 PI 22B-6 CO 22B-1 PI 22B-7

BAY 22B

MATCHLINE-A

NOTE TO INSPECTORS: SKETCH AND CONFIRM FRAMING IN THIS AREA

PRESS ROOM

No. 1

MATCHLINE-B

20'-0" | 31'-2" | 28'-10" | 12'-0" | 15'-7 7/16" | 21'-5" | 21'-5 9/16" | 21'-5½" | 21'-5" | 7'-1½"

LAND SIDE

NORTH

1 SUPERSTRUCTURE: DECK UNDERSIDE PLAN - UNIT-B
1/8" = 1'-0"

PLOTTED BY: McGrath, Lela (3/31/2017 - 3:31 PM)
LAST SAVED BY: LSARC (3/31/2017 - 3:28 PM)
FILE LOCATION: E:\Port of Houston\Wharf 41 - Representative Drawings

PORT OF HOUSTON AUTHORITY
HOUSTON, TEXAS

PORT OF HOUSTON AUTHORITY

CONSULTANT:

SEAL:

REPRESENTATIVE DRAWINGS
NOT FOR CONSTRUCTION

PROJECT TITLE:

FACILITY INSPECTION & CONDITION ASSESSMENT PROGRAM (FICAP)

SHEET TITLE:

BASELINE DRAWINGS FOR WHARF No. 41:

LOWER PLAN PILE AND BULKHEAD ELEMENTS - UNIT B

No.	DATE	DESCRIPTION

DATE:	10-17-2016
DESIGNER:	JCK
CHECKED BY:	CJL
CADD:	DMC / CLM
SCALE:	AS NOTED

DRAWING No: XXX–XXX–XXX

SHEET No: G–142

REV. No:

SHIP CHANNEL → DOWNSTREAM

23 ℄ EXP. JOINT | 24 | 25 | 26 | 27 | 28 | 29 | 30 | 31 | 32 | 33 ℄ EXP. JOINT

100'-0" | 100'-0"

20'-0" (BAY **23**) | 20'-0" (BAY **24**) | 20'-0" (BAY **25**) | 20'-0" (BAY **26**) | 20'-0" (BAY **27**) | 20'-0" (BAY **28**) | 20'-0" (BAY **29**) | 20'-0" (BAY **30**) | 20'-0" (BAY **31**) | 20'-0" (BAY **32**)

WHARF No. 42 (*NOT IN SCOPE*)

MATCHLINE-B

MATCHLINE-C

6'-9" | 5'-0" | 6'-9" | 6'-9" | 5'-0" | 9'-3" | 3'-0" | 86'-9" | 20'-6" | 20'-6" | 3'-3"

PI 23A-1 PI 24A-1 PI 25A-1 PI 26A-1 PI 27A-1 PI 28A-1 PI 29A-1 PI 30A-1 PI 31A-1 PI 32A-1

PI 23A-3 PI 23A-5 PI 23A-7 PI 23A-9 PI 23A-11

PI 24A-2 PI 24A-3 PI 24A-4 PI 24A-5 PI 24A-6 PI 24A-7 PI 24A-8 PI 24A-9 PI 24A-10 PI 24A-11 PI 24A-12 PI 24A-13

PI 25A-2 PI 25A-3 PI 25A-4 PI 25A-5 PI 25A-6 PI 25A-7 PI 25A-8 PI 25A-9 PI 25A-10 PI 25A-11 PI 25A-12 PI 25A-13

PI 26A-2 PI 26A-3 PI 26A-4 PI 26A-5 PI 26A-6 PI 26A-7 PI 26A-8 PI 26A-9 PI 26A-10 PI 26A-11 PI 26A-12 PI 26A-13

PI 27A-2 PI 27A-3 PI 27A-4 PI 27A-5 PI 27A-6 PI 27A-7 PI 27A-8 PI 27A-9 PI 27A-10 PI 27A-11 PI 27A-12 PI 27A-13

PI 28A-2 PI 28A-3 PI 28A-4 PI 28A-5 PI 28A-6 PI 28A-7 PI 28A-8 PI 28A-9 PI 28A-10 PI 28A-11 PI 28A-12 PI 28A-13

PI 29A-2 PI 29A-3 PI 29A-4 PI 29A-5 PI 29A-6 PI 29A-7 PI 29A-8 PI 29A-9 PI 29A-10 PI 29A-11 PI 29A-12 PI 29A-13

PI 30A-2 PI 30A-3 PI 30A-4 PI 30A-5 PI 30A-6 PI 30A-7 PI 30A-8 PI 30A-9 PI 30A-10 PI 30A-11 PI 30A-12 PI 30A-13

CL TRACK

PI 31A-2 PI 31A-3 PI 31A-4 PI 31A-5 PI 31A-6 PI 31A-7 PI 31A-8 PI 31A-9 PI 31A-10 PI 31A-11 PI 31A-12 PI 31A-13

PI 32A-2 PI 32A-3 PI 32A-4 PI 32A-5 PI 32A-6 PI 32A-7 PI 32A-8 PI 32A-9 PI 32A-10 PI 32A-11 PI 32A-12 PI 32A-13

BAY 23A | BAY 24A | BAY 25A | BAY 26A | BAY 27A | BAY 28A | BAY 29A | BAY 30A | BAY 31A | BAY 32A

PI 23B-1 PI 23B-2 PI 23B-3 PI 23B-4 PI 23B-5 PI 23B-6 PI 23B-7 PI 23B-8 PI 23B-9 PI 23B-10 PI 23B-11 PI 23B-12 PI 23B-13 PI 23B-14 PI 23B-15

BAY 23B

PI 24B-1 PI 24B-2 PI 24B-3 PI 24B-4 PI 24B-5 PI 24B-6 PI 24B-7 PI 24B-8 PI 24B-9 PI 24B-10

BAY 24B

PI 25B-1 PI 25B-2 PI 25B-3 PI 25B-4 PI 25B-5 PI 25B-6 PI 25B-7 PI 25B-8 PI 25B-9 PI 25B-10 PI 25B-11 PI 25B-12 PI 25B-13 PI 25B-14 PI 25B-15 PI 25B-16 PI 25B-17 PI 25B-18 PI 25B-19 PI 25B-20

BAY 25B

PI 26B-1 PI 26B-2 PI 26B-3 PI 26B-4 PI 26B-5 PI 26B-6 CO 26B-1 PI 26B-7 PI 26B-8 PI 26B-9 PI 26B-10 PI 26B-11 PI 26B-12 PI 26B-13 PI 26B-14 PI 26B-15 PI 26B-16 PI 26B-17

BAY 26B

PI 27B-1 PI 27B-2 PI 27B-3 PI 27B-4 PI 27B-5 PI 27B-6 CO 27B-1 PI 27B-7 PI 27B-8 PI 27B-9 PI 27B-10 PI 27B-11 PI 27B-12 PI 27B-13 PI 27B-14 PI 27B-15 PI 27B-16 PI 27B-17

BAY 27B

PI 28B-1 PI 28B-2 PI 28B-3 PI 28B-4 PI 28B-5 PI 28B-6 CO 28B-1 PI 28B-7 PI 28B-8 PI 28B-9 PI 28B-10 PI 28B-11 PI 28B-12 PI 28B-13 PI 28B-14 PI 28B-15 PI 28B-16 PI 28B-17

BAY 28B

PI 29B-1 PI 29B-2 PI 29B-3 PI 29B-4 PI 29B-5 PI 29B-6 CO 29B-1 PI 29B-7 PI 29B-8 PI 29B-9 PI 29B-10 PI 29B-11 PI 29B-12 PI 29B-13 PI 29B-14 PI 29B-15 PI 29B-16 PI 29B-17

BAY 29B

PI 30B-1 PI 30B-2 PI 30B-3 PI 30B-4 PI 30B-5 PI 30B-6 PI 30B-7 CO 30B-1 PI 30B-8 PI 30B-9 PI 30B-10 PI 30B-11 PI 30B-12 PI 30B-13 PI 30B-14 PI 30B-15 PI 30B-16 PI 30B-17 PI 30B-18 PI 30B-19 PI 30B-20 PI 30B-21

BAY 30B

PI 31B-1 PI 31B-2 PI 31B-3 PI 31B-4 PI 31B-5 PI 31B-6 PI 31B-7 PI 31B-8 PI 31B-9 PI 31B-10

BAY 31B

PI 32B-1 PI 32B-2 PI 32B-3 PI 32B-4 PI 32B-5 PI 32B-6 PI 32B-7 PI 32B-8 PI 32B-9 PI 32B-10 PI 32B-11 PI 32B-12 PI 32B-13 PI 32B-14 PI 32B-15 PI 32B-16

BAY 32B

MATCHLINE-B

No. 1

No. 2

MATCHLINE-C

18'-6½" | 12'-10¾" | 25'-8¼" | 21'-5" | 21'-5½" | 21'-5½" | 21'-5" | 25'-8¼" | 12'-10¾" | 18'-6½"

LAND SIDE

NORTH

1 SUPERSTRUCTURE: DECK UNDERSIDE PLAN - UNIT-C
1/8" = 1'-0"

PORT OF HOUSTON AUTHORITY
HOUSTON, TEXAS

PORT OF HOUSTON AUTHORITY

CONSULTANT:

SEAL:

REPRESENTATIVE DRAWINGS
NOT FOR CONSTRUCTION

PROJECT TITLE:

FACILITY INSPECTION & CONDITION ASSESSMENT PROGRAM (FICAP)

SHEET TITLE:

BASELINE DRAWINGS FOR WHARF No. 41:

LOWER PLAN PILE AND BULKHEAD ELEMENTS - UNIT C

No.	DATE	DESCRIPTION

DATE:	10-17-2016
DESIGNER:	JCK
CHECKED BY:	CJL
CADD:	DMC / CLM
SCALE:	AS NOTED

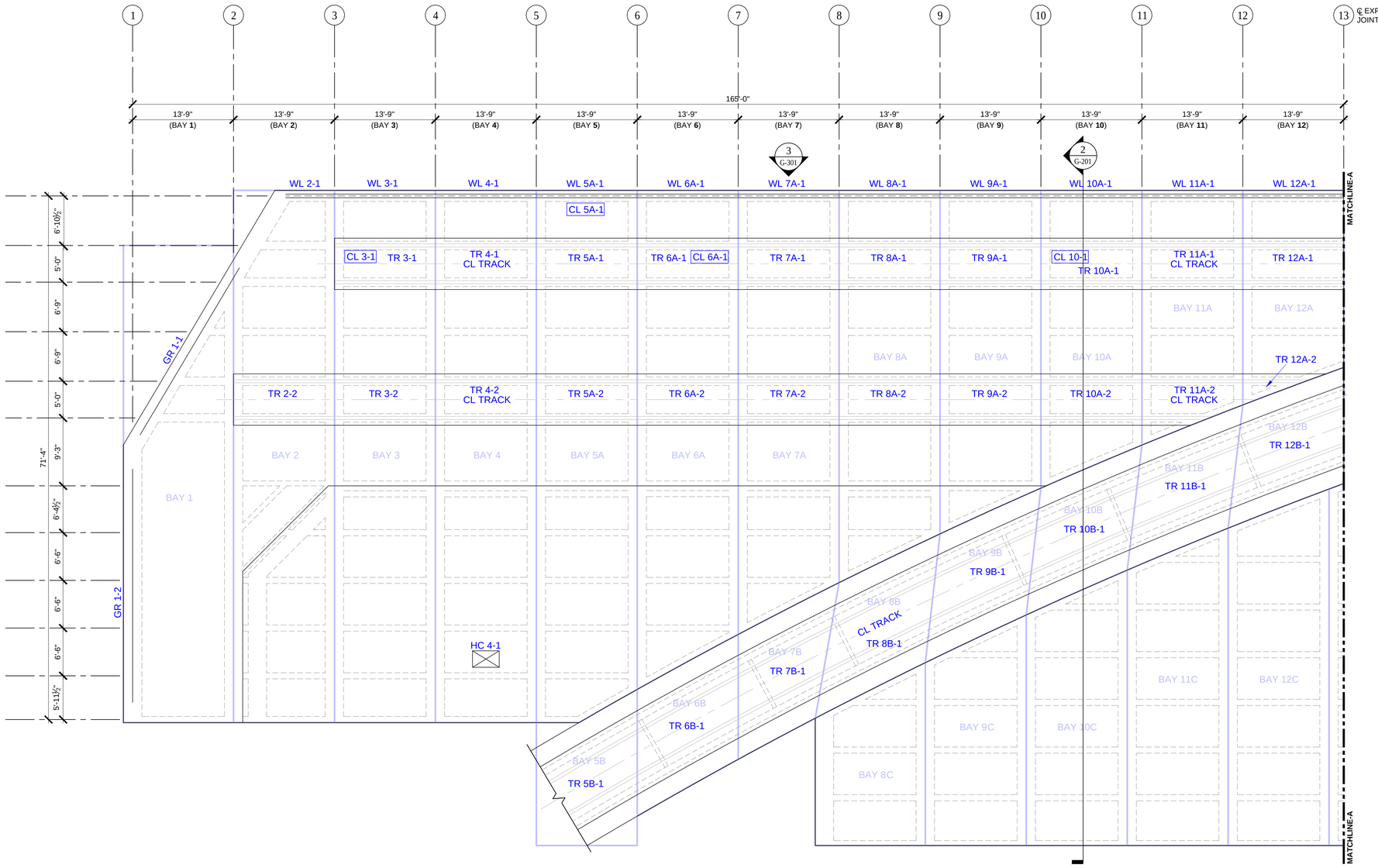
DRAWING No: XXX–XXX–XXX

SHEET No: G–143

REV. No:

PLOTTED BY: McCreedy, Leah (3/31/2017 - 2:31 PM)
LAST SAVED BY: LSARC (3/31/2017 - 2:28 PM)
FILE LOCATION: E:\Port of Houston\Wharf 41 - Representative Drawings

SHIP CHANNEL → DOWNSTREAM



LAND SIDE

NORTH

1 TOPSIDE DECK: ANCILLARY COMPONENT PLAN - UNIT-A
1/8" = 1'-0"

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HOUSTON, TEXAS

PORT OF HOUSTON AUTHORITY

CONSULTANT:

SEAL:

REPRESENTATIVE DRAWINGS
NOT FOR CONSTRUCTION

PROJECT TITLE:

FACILITY INSPECTION & CONDITION ASSESSMENT PROGRAM (FICAP)

SHEET TITLE:

BASELINE DRAWINGS FOR WHARF No. 41:

UPPER PLAN ANCILLARY AND MOORING ELEMENTS - UNIT A

No.	DATE	DESCRIPTION

DATE:	10-17-2016
DESIGNER:	JCK
CHECKED BY:	CJL
CADD:	DMC / CLM
SCALE:	AS NOTED

DRAWING No: XXX–XXX–XXX

SHEET No: G–151

REV. No:

PLOTTED BY: McCready, Leila (3/31/2017 - 3:31 PM)
LAST SAVED BY: LSAHC (3/31/2017 - 5:28 PM)
FILE LOCATION: E:\Port of Houston\Wharf 41 - Representative Drawings

SHIP CHANNEL → DOWNSTREAM

13 ℄ EXP. JOINT | 14 | 15 | 16 | 17 ℄ EXP. JOINT | 18 | 19 | 20 | 21 | 22 | 23 ℄ EXP. JOINT

80'-0" | 120'-6"

20'-0" (BAY **13**) | 20'-0" (BAY **14**) | 20'-0" (BAY **15**) | 20'-0" (BAY **16**) | 20'-6" (BAY **17**) | 20'-0" (BAY **18**) | 20'-0" (BAY **19**) | 20'-0" (BAY **20**) | 20'-0" (BAY **21**) | 20'-0" (BAY **22**)

MATCHLINE-A

BAY 13A | BAY 14A | BAY 15A | BAY 16A | BAY 17A | BAY 18A | BAY 19A | BAY 20A | BAY 21A | BAY 22A

CL 13A-1 | CL TRACK | CL 15A-1 | CL 19A-1 | CL TRACK

CL TRACK

MATCHLINE-B

7'-1"
7'-0⅛"
6'-11⅞"
5'-11½"
8'-5"
4'-6⅞"
82'-4½"
1'-8⅞₁₆"
20'-2⅛"
20'-6"

BAY 14B | BAY 13B | BAY 14C | BAY 16B | BAY 17B | BAY 17C | BAY 18B | BAY 19B | BAY 20B | BAY 21B | BAY 22B | BAY 14D

UT 17B-1 | UT 17C-1 | UT 18B-1 | UT 19B-1 | UT 20B-1 | UT 21B-1 | UT 22B-1

UT 17B-2 | UT 17C-2 | UT 18B-2 | UT 19B-2 | UT 20B-2 | UT 21B-2 | UT 22B-2

UT 17C-3 | UT 18B-3 | UT 19B-3 | UT 20B-3 | UT 21B-3 | UT 22B-3

UT 17B-3

MATCHLINE-A

PRESS ROOM | No. 1

MATCHLINE-B

20'-0" | 31'-2" | 28'-10" | 12'-0" | 15'-7⁷⁄₁₆" | 21'-5" | 21'-5⁹⁄₁₆" | 21'-5½" | 21'-5" | 7'-1½"

NORTH

1 TOPSIDE DECK: ANCILLARY COMPONENT PLAN - UNIT-B
1/8" = 1'-0"

LAND SIDE

PLOTTED BY: McCreedy, Leah (3/31/2017 - 2:33 PM)
LAST SAVED BY: LSAMC (3/31/2017 - 2:33 PM)
FILE LOCATION: E:\Port of Houston\Wharf 41 - Representative Drawings

PORT OF HOUSTON AUTHORITY

CONSULTANT:

SEAL:

REPRESENTATIVE DRAWINGS
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PROJECT TITLE:

FACILITY INSPECTION & CONDITION ASSESSMENT PROGRAM (FICAP)

SHEET TITLE:

BASELINE DRAWINGS FOR WHARF No. 41:

UPPER PLAN ANCILLARY AND MOORING ELEMENTS - UNIT B

No.	DATE	DESCRIPTION

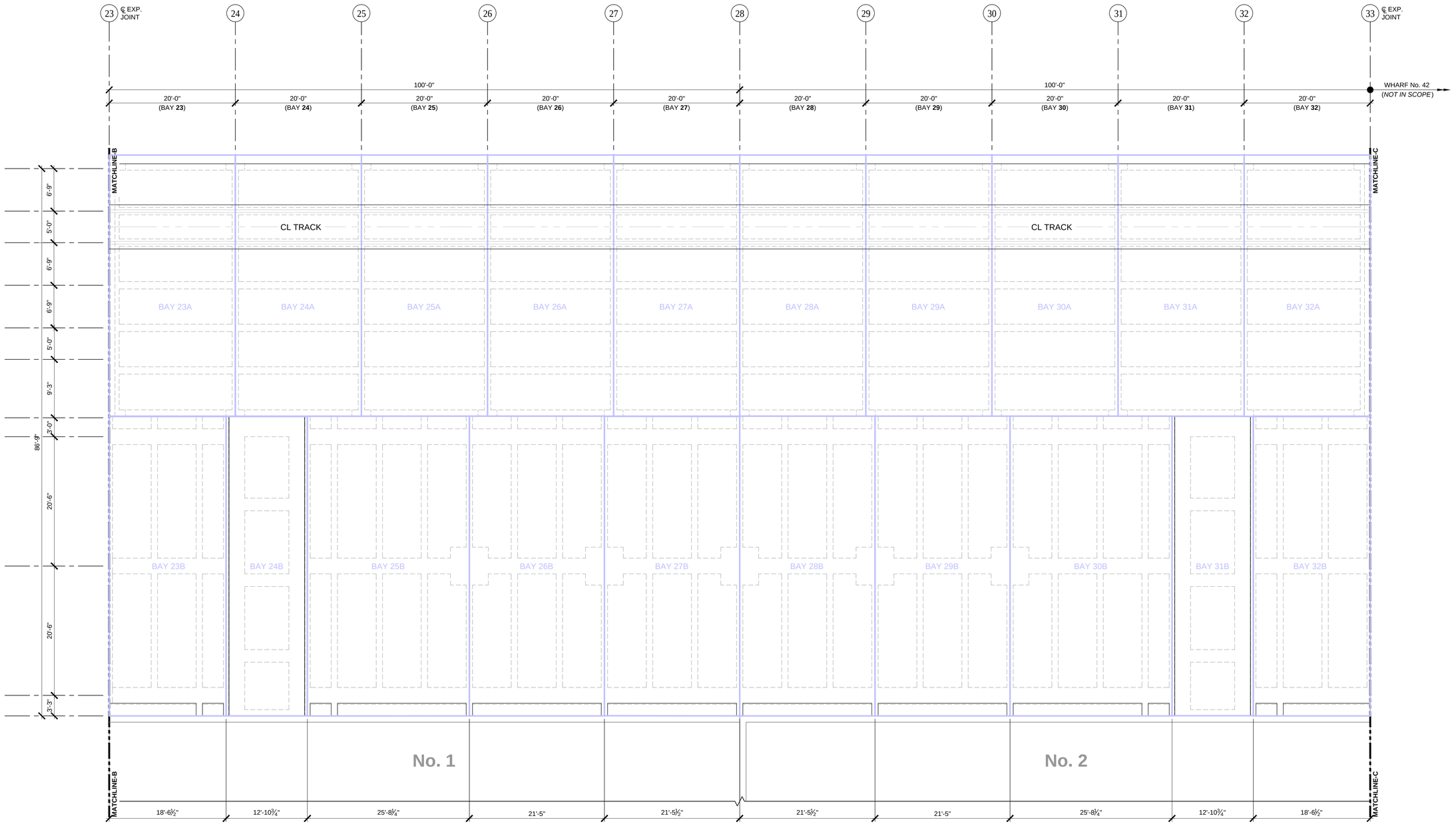
DATE:	10-17-2016
DESIGNER:	JCK
CHECKED BY:	CJL
CADD:	DMC / CLM
SCALE:	AS NOTED

DRAWING No: XXX–XXX–XXX

SHEET No: G–152

REV. No:

SHIP CHANNEL → DOWNSTREAM



LAND SIDE

NORTH

1 TOPSIDE DECK: ANCILLARY COMPONENT PLAN - UNIT-C
1/8" = 1'-0"

PORT OF HOUSTON AUTHORITY
HOUSTON, TEXAS

PORT OF HOUSTON AUTHORITY

CONSULTANT:

SEAL:

REPRESENTATIVE DRAWINGS
NOT FOR CONSTRUCTION

PROJECT TITLE:

FACILITY INSPECTION & CONDITION ASSESSMENT PROGRAM (FICAP)

SHEET TITLE:

BASELINE DRAWINGS FOR WHARF No. 41:

UPPER PLAN ANCILLARY AND MOORING ELEMENTS - UNIT C

No.	DATE	DESCRIPTION

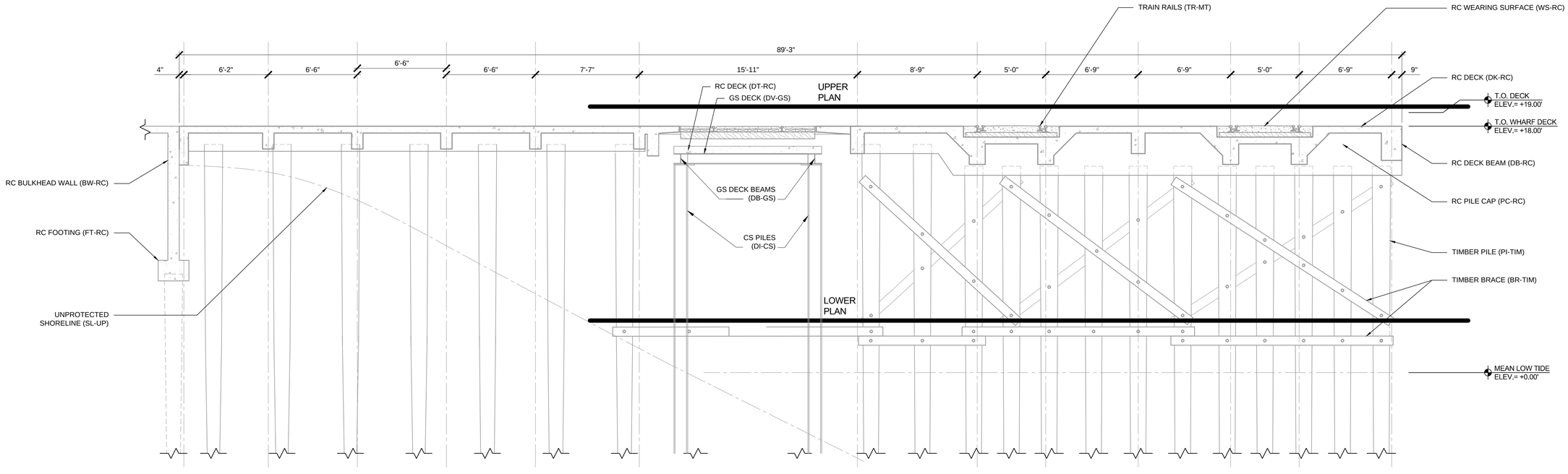
DATE:	10-17-2016
DESIGNER:	JCK
CHECKED BY:	CJL
CADD:	DMC / CLM
SCALE:	AS NOTED

DRAWING No: XXX–XXX–XXX

SHEET No: G–153

REV. No:

PLOTTED BY: McCready, Leila (3/31/2017 - 3:32 PM)
LAST SAVED BY: LSARC (3/31/2017 - 3:28 PM)
FILE LOCATION: E:\Port of Houston\Wharf 41 - Representative Drawings



1 SECTION THROUGH 1938 ADDITION & RAILROAD TRESTLE
1/4" = 1'-0"

PORT OF HOUSTON AUTHORITY

CONSULTANT:

SEAL:

REPRESENTATIVE DRAWINGS
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PROJECT TITLE:

FACILITY INSPECTION & CONDITION ASSESSMENT PROGRAM (FICAP)

SHEET TITLE:

BASELINE DRAWINGS FOR WHARF No. 41:

SECTIONS & ELEVATIONS

No.	DATE	DESCRIPTION

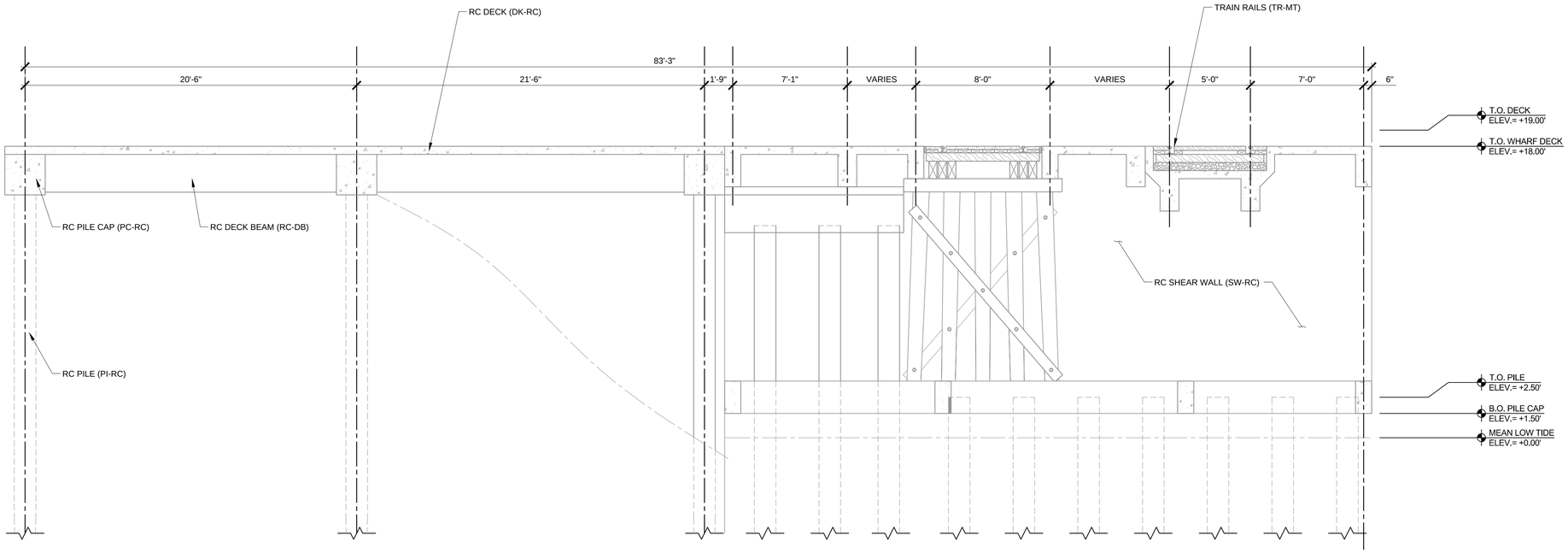
DATE:	10-17-2016
DESIGNER:	JCK
CHECKED BY:	CJL
CADD:	DMC / CLM
SCALE:	AS NOTED

DRAWING No: XXX-XXX-XXX

SHEET No: G-201

REV. No:

PLOTTED BY: McCreath, Lela (3/31/2017 - 2:23 PM)
LAST SAVED BY: LSAMC (3/31/2017 - 2:29 PM)
FILE LOCATION: E:\Port of Houston\Wharf-41 - Representave Drawings



SECTION THROUGH 1926 EXTENSION & 1924 PRESS ROOM (1)
1/4" = 1'-0"

PORT OF HOUSTON AUTHORITY

CONSULTANT:

SEAL:

REPRESENTATIVE DRAWINGS

NOT FOR CONSTRUCTION

PROJECT TITLE:

FACILITY INSPECTION & CONDITION ASSESSMENT PROGRAM (FICAP)

SHEET TITLE:

BASELINE DRAWINGS FOR WHARF No. 41:

SECTIONS & ELEVATIONS

No.	DATE	DESCRIPTION

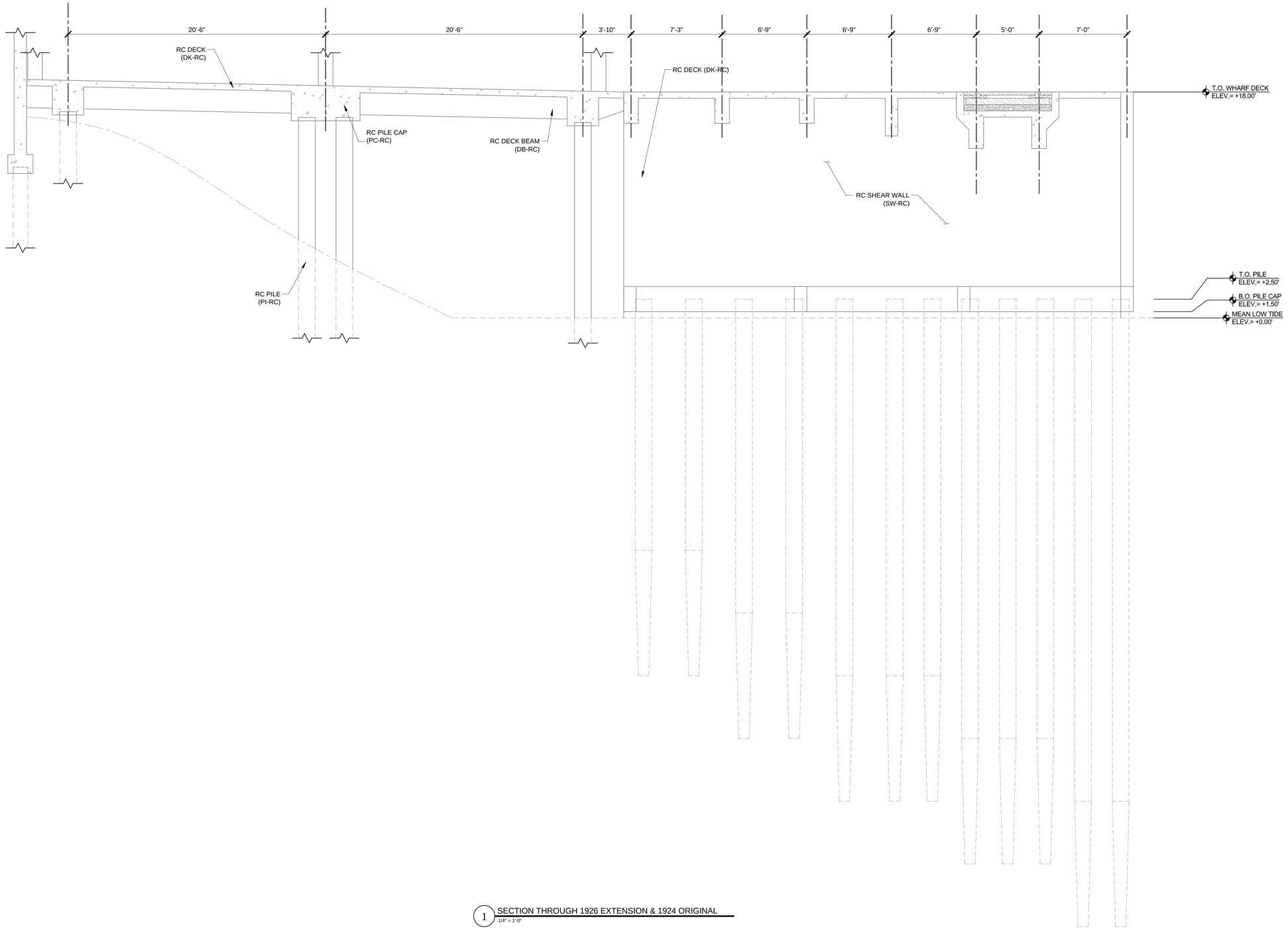
DATE:	10-17-2016
DESIGNER:	JCK
CHECKED BY:	CJL
CADD:	DMC / CLM
SCALE:	AS NOTED

DRAWING No: XXX–XXX–XXX

SHEET No: G–202

REV. No:

PLOTTED BY: McGrath, Lela (3/31/2017 - 3:32 PM)
LAST SAVED BY: LSARC (3/31/2017 - 3:29 PM)
FILE LOCATION: E:\Port of Houston\Wharf 41 - Representative Drawings



1 SECTION THROUGH 1926 EXTENSION & 1924 ORIGINAL
1/4" = 1'-0"

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HOUSTON, TEXAS

PORT OF HOUSTON AUTHORITY

CONSULTANT:

SEAL:

REPRESENTATIVE DRAWINGS

NOT FOR CONSTRUCTION

PROJECT TITLE:

FACILITY INSPECTION & CONDITION ASSESSMENT PROGRAM (FICAP)

SHEET TITLE:

BASELINE DRAWINGS FOR WHARF No. 41:

SECTIONS & ELEVATIONS

No.	DATE	DESCRIPTION

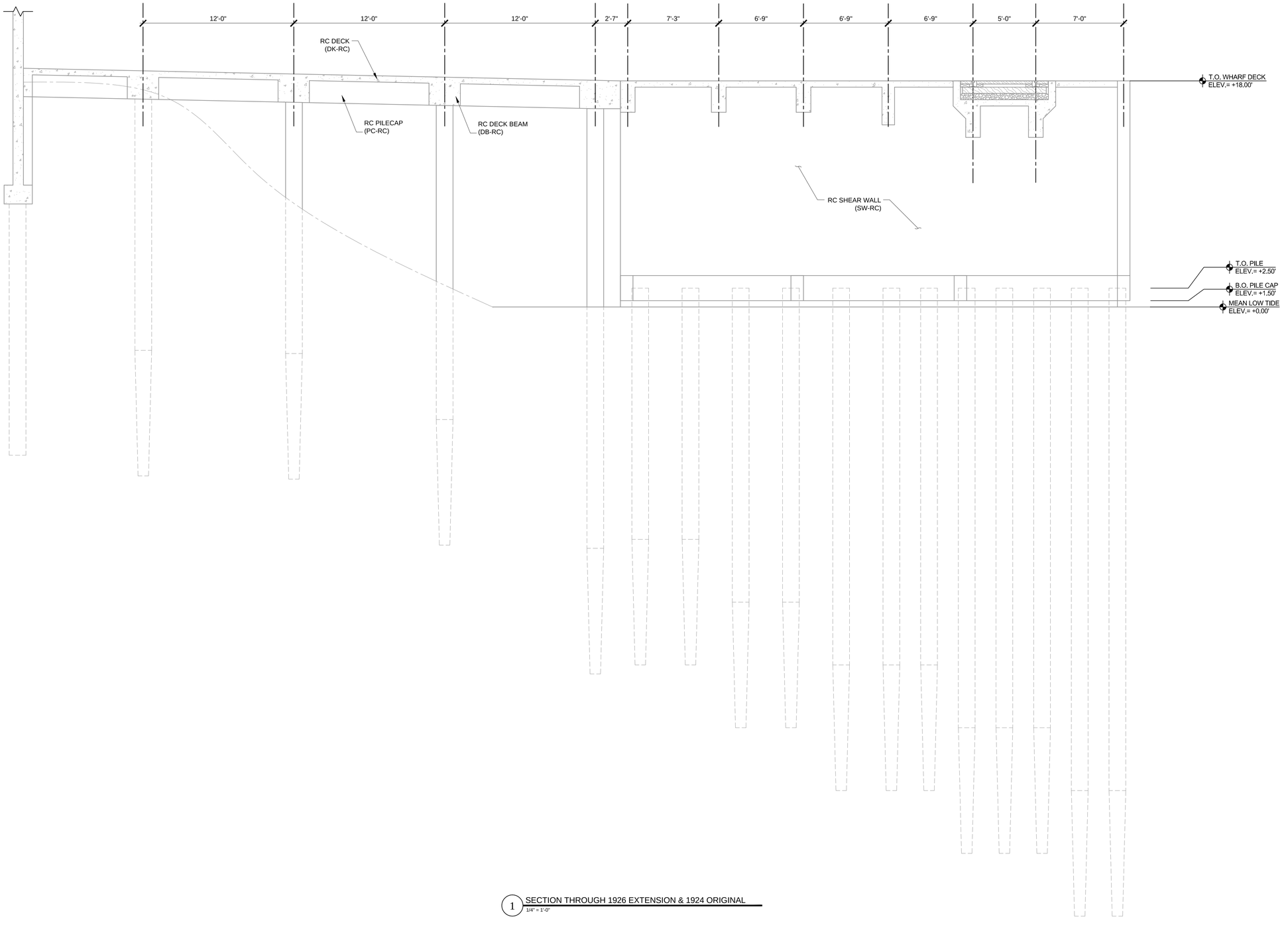
DATE:	10-17-2016
DESIGNER:	JCK
CHECKED BY:	CJL
CADD:	DMC / CLM
SCALE:	AS NOTED

DRAWING No: XXX–XXX–XXX

SHEET No: G–203

REV. No:

PLOTTED BY: McCready, Leah (2/13/2017 - 3:32 PM)
LAST SAVED BY: LSMRC (2/13/2017 - 2:29 PM)
FILE LOCATION: E:\Port of Houston\Wharf-41 - Representative Drawings



1 SECTION THROUGH 1926 EXTENSION & 1924 ORIGINAL
1/4" = 1'-0"

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HOUSTON, TEXAS

PORT OF HOUSTON AUTHORITY

CONSULTANT:

SEAL:

REPRESENTATIVE DRAWINGS

NOT FOR CONSTRUCTION

PROJECT TITLE:

FACILITY INSPECTION & CONDITION ASSESSMENT PROGRAM (FICAP)

SHEET TITLE:

BASELINE DRAWINGS FOR WHARF No. 41:

SECTIONS & ELEVATIONS

No.	DATE	DESCRIPTION

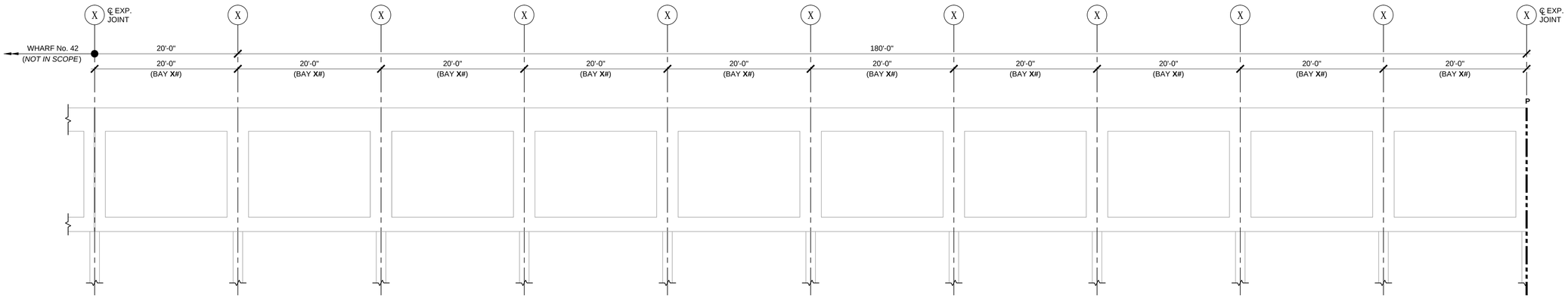
DATE:	10-17-2016
DESIGNER:	JCK
CHECKED BY:	CJL
CADD:	DMC / CLM
SCALE:	AS NOTED

DRAWING No: XXX-XXX-XXX

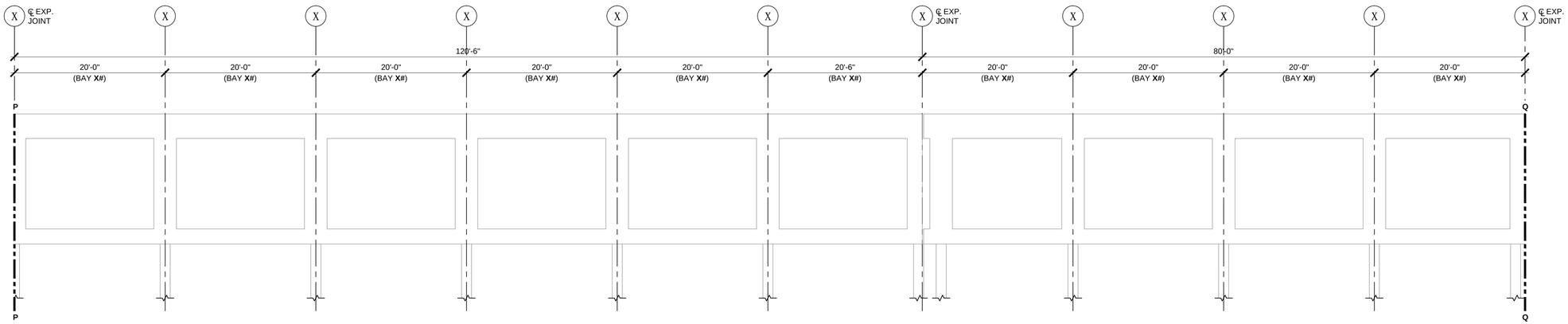
SHEET No: G-204

REV. No:

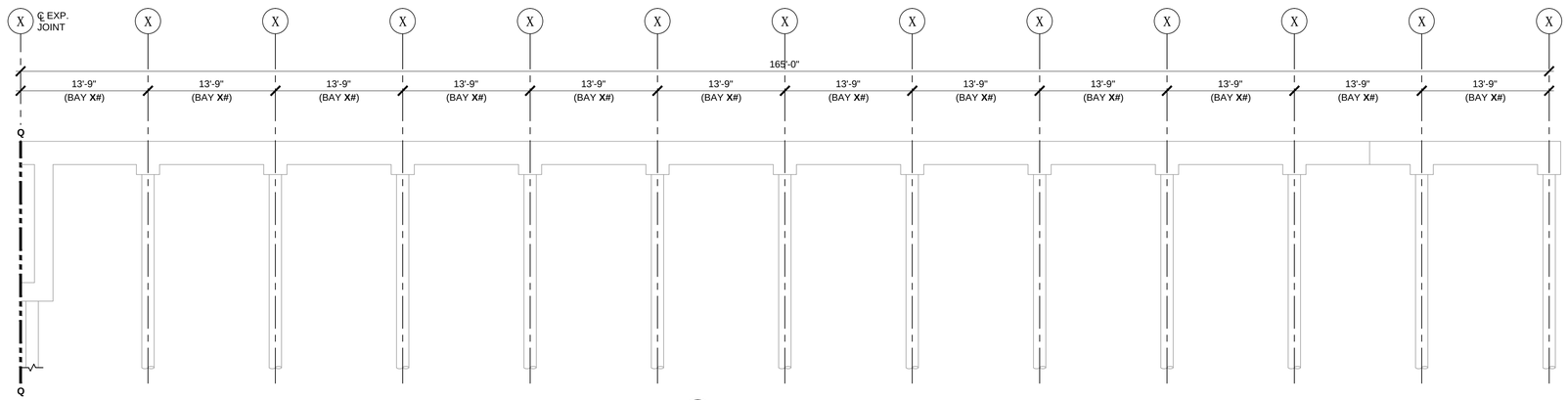
PLOTTED BY: McCreedy, Leah (2/13/2017 - 2:32 PM)
LAST SAVED BY: LSMRC (2/13/2017 - 2:29 PM)
FILE LOCATION: E:\Port of Houston\Wharf-41 - Representative Drawings



1 FRONT ELEVATION: UNIT-C
1/8" = 1'-0"



2 FRONT ELEVATION: UNIT-B
1/8" = 1'-0"



3 FRONT ELEVATION: UNIT-A
1/8" = 1'-0"

PLOTTED BY: McCready, Leda (3/31/2017 - 3:32 PM)
LAST SAVED BY: LSAIR (3/31/2017 - 3:29 PM)
FILE LOCATION: E:\Port of Houston\Wharf 41 - Representative Drawings

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CONSULTANT:

SEAL:

REPRESENTATIVE DRAWINGS

NOT FOR CONSTRUCTION

PROJECT TITLE:

FACILITY INSPECTION & CONDITION ASSESSMENT PROGRAM (FICAP)

SHEET TITLE:

BASELINE DRAWINGS FOR WHARF No. 41:

BERTHING SYSTEM ELEVATIONS

No.	DATE	DESCRIPTION

DATE:	10-17-2016
DESIGNER:	JCK
CHECKED BY:	CJL
CADD:	DMC / CLM
SCALE:	AS NOTED

DRAWING No: XXX–XXX–XXX

SHEET No: G–301

REV. No: