CHAPTER 4

RESULTS AND DISCUSSION

Study: A Five-Phase Conceptual Framework for Climate Change Adaptation and Resilience Enhancement of Metro Rail Transit Line 3 Infrastructure in the Philippines

Instrument: MRT-3 Infrastructure Vulnerability Assessment (Sections A–C) **Returned forms:** 8

4.1 Overview of the Infrastructure Vulnerability Assessment

This chapter presents the results of the MRT-3 Infrastructure Vulnerability Assessment, an accomplished-form instrument administered to technical and operations personnel of the Metro Rail Transit Line 3. Eight assessment forms were returned, each covering a distinct infrastructure component of the line. The instrument is organised into three sections: Section A records general component information, Section B records a structured physical condition evaluation based on visual inspection, and Section C records specific climate vulnerability indicators across four hazard groups — flood (C1), seismic (C2), extreme temperature fluctuation (C3) and wind or typhoon exposure (C4) — culminating in an overall vulnerability rating (C5) scored on a four-point scale from Low (1) to Critical (4).

Section C is disaggregated by material, with separate response columns for concrete and for steel. Where a component is of a single primary material, the corresponding column was completed and the other was left blank. This is reported in the tables that follow as recorded, and is treated in Section 4.6 as a data consideration rather than as a substantive negative response. Results are presented section by section, and each set of results is followed by its discussion.

Throughout this chapter the eight assessed components are referred to by the codes assigned in Table 1. Locations, dates, material designations and free-text remarks are reproduced exactly as recorded on the returned forms.

4.2 Section A — General Component Information

4.2.1 Component coverage and material composition

The eight returned forms cover eight distinct component categories offered by the instrument. Only the "Other" category was unused; Power Infrastructure was assessed twice, once for the electrical equipment of the traction and station power system and once for the steel elements of the overhead catenary system. Table 1 presents the inventory.

Table 1. Inventory and general information of the eight assessed MRT-3 components (Section A)

Code	Component type	Location / segment recorded	Primary material	Year installed	Last major inspection or rehabilitation
CP-1	Track Section (elevated)	Ayala; both bounds	Steel (Nippon Rail / 54E1)	1999	2019
CP-2	Station Building (platform, concourse, roof)	Stretch of EDSA, North Ave. to Taft Ave.; both bounds	Concrete, steel and masonry	1996	None recorded
CP-3	Drainage System (culvert, canal, pump station)	Stretch of EDSA, North Ave. to Taft Ave.; both bounds	Concrete	1996–2000	None recorded
CP-4	Power Infrastructure — electrical equipment	14 locations (depot and Stations 1–13); Ayala	Other: electrical equipment	1999	2025 (partial)
CP-5	Power Infrastructure — overhead catenary system	Not recorded	Steel	1999	2017–2019
CP-6	Elevated Structure (beam, pier)	Guadalupe; northbound	Concrete	1998	October 2025
CP-7	Bridge Structure	Guadalupe station; both bounds	Steel	1997	January 2026
CP-8	Tunnel Section	Buendia station; both bounds	Concrete	1996	Not recorded

Entries reproduce the forms as accomplished. CP-5 records no location; the justification entered under C5 for this component refers to balance weights and secured foundations, which is consistent with overhead catenary equipment.

4.2.2 Structural age

All eight components were installed between 1996 and 2000, giving a service age of approximately twenty-six to thirty years at the time of assessment. The oldest components are the Station Building, the Drainage System and the Tunnel Section, all dating from 1996; the Drainage System is recorded with a construction period rather than a single year, running from 1996 to 2000. No component of more recent vintage was assessed, and the sample therefore contains no age variation of practical significance: the entire assessed asset base belongs to the original construction of the line.

4.2.3 Inspection and rehabilitation recency

Item A.5 produced the most differentiated result in Section A. Three of the eight components — CP-2 Station Building, CP-3 Drainage System and CP-8 Tunnel Section — carry no recorded major inspection or rehabilitation. Of the remaining five, two carry records within the twelve months preceding the assessment (CP-6, October 2025; CP-7, January 2026), one is partial and recent (CP-4, 2025), and two are five or more years old (CP-1, 2019; CP-5, 2017–2019).

Table 2. Distribution of recorded inspection and rehabilitation recency

Recency category	n	Components
Within the preceding 12 months	2	CP-6 Elevated Structure; CP-7 Bridge Structure
Within the preceding 24 months (partial)	1	CP-4 Power Infrastructure — electrical equipment

Recency category	n	Components
Five or more years elapsed	2	CP-1 Track Section (2019); CP-5 Overhead catenary (2017–2019)
No record entered	3	CP-2 Station Building; CP-3 Drainage System; CP-8 Tunnel Section

Discussion of Section A results

The inspection-recency pattern is not random with respect to component class. The three components with no recorded inspection or rehabilitation are the passive civil and hydraulic assets — the station buildings, the drainage system and the tunnel section — while the components with recent records are the structural elements at Guadalupe and the power equipment. Structural and electromechanical assets, in other words, are receiving documented attention; the building envelope and the drainage network are not.

This matters because the drainage system is the component whose condition governs the flood exposure reported later in Section C, and the station buildings are where that exposure is realised as service disruption. An asset that is not inspected cannot generate a condition record, and a component with no condition record will tend to be rated by recall rather than by evidence. The absence of inspection documentation for precisely those components should therefore be read as a finding in its own right, and not merely as missing data.

The uniform age profile also constrains interpretation. Because every assessed component dates from the original construction of the line, the assessment cannot distinguish deterioration attributable to age from deterioration attributable to climatic loading; both act over the same twenty-six to thirty-year interval on every component in the sample.

4.3 Section B — Physical Condition Evaluation

4.3.1 Overall condition ratings

Item B.1 asks for a single overall condition rating on a five-point scale from Excellent to Critical. Two components were rated Excellent and six were rated Good. No component was rated Fair, Poor or Critical. The respondent completing CP-7 Bridge Structure annotated two levels rather than one, marking Excellent with the qualifier "No visual defects on the steel itself" and annotating Good with "For concrete, good condition."

Table 3. Overall physical condition ratings (Item B.1)

Rating	n	Components
Excellent — no visible defects	2	CP-4 Power Infrastructure (electrical equipment); CP-7 Bridge Structure (steel elements; concrete separately annotated as Good)
Good — minor aesthetic defects, no structural concern	6	CP-1, CP-2, CP-3, CP-5, CP-6, CP-8
Fair — moderate defects, some structural concern	0	—
Poor — significant defects, clear structural concern	0	—
Critical — severe damage, safety risk	0	—

4.3.2 Observed defects by type and severity

Item B.2 disaggregates condition into six defect categories. Table 4 presents the recorded severity for each component and Figure 1 summarises the distribution. Cracking produced the widest spread of responses: three components recorded no cracking, one recorded hairline cracking below 0.1 mm, three recorded minor cracking between 0.1 mm and 1.0 mm, and one — CP-7 Bridge Structure — recorded moderate cracking between 1.0 mm and 5.0 mm at the concrete plinths approaching the steel bridge. No component recorded severe or propagating cracking.

Table 4. Recorded severity of observed defects by component (Item B.2)

Code	Cracking	Spalling	Water intrusion	Settlement	Vegetation	Corrosion (steel)
CP-1	None	None	None	Minor observable	Minor	None
CP-2	Hairline (<0.1 mm)	Minor (surface flaking)	Minor damp patches	None	Minor	Minor (surface rust)
CP-3	None	None	None	None	None	Not answered
CP-4	None	None	None	None	None	None
CP-5	Minor (0.1–1.0 mm)	None	None	None	Minor	None
CP-6	Minor (0.1–1.0 mm)	None	Mold / algae growth	Minor observable	Minor	None
CP-7	Moderate (1.0–5.0 mm)	None	None	None	None	None

Code	Cracking	Spalling	Water intrusion	Settlement	Vegetation	Corrosion (steel)
CP-8	Minor (0.1–1.0 mm)	Minor (surface flaking)	Minor damp patches	None	Minor	Minor (surface rust)

Table 5. Location descriptions and additional defects recorded in free text (Items B.2.1 and B.2.3)

Code	Recorded location or description	Other visible damage and severity (B.2.3)
CP-1	No locations entered	Corrugation / stamping — severity: Low
CP-2	No locations entered	None entered
CP-6	Minor cracking along the main line at concrete plinths; mold and algae at some locations in-between viaducts; settlement observed at Guadalupe during construction; small vegetation due to accumulation of soil and dust	Along the mainline, some piers observed with small or minor cracks — severity: minor
CP-7	Moderate cracking at concrete plinths before the steel bridge	None entered

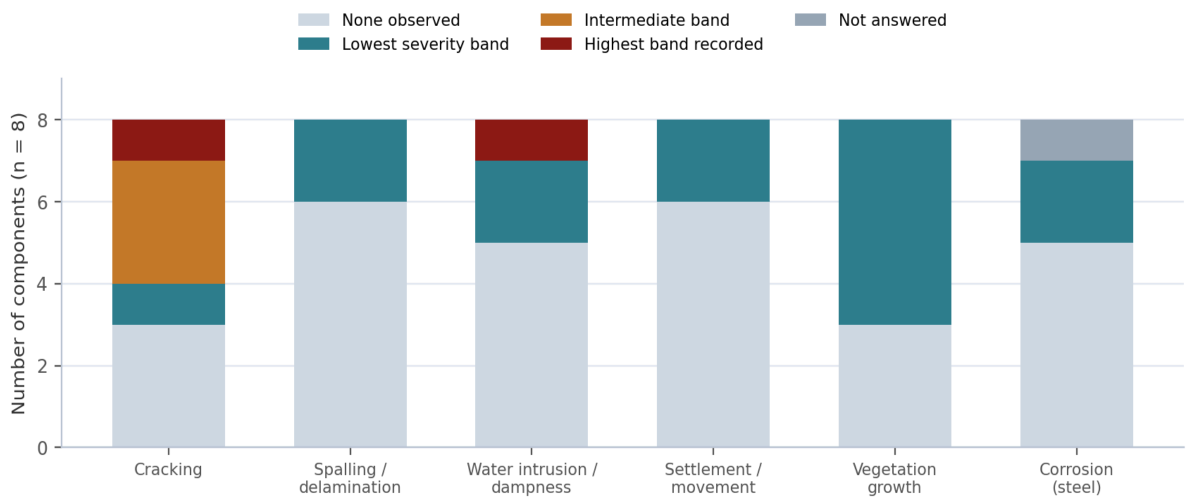

Figure 1. Frequency of recorded defect severities across the eight assessed components.

Discussion of Section B results

Two features of the Section B results require comment. The first is the compression of the condition ratings at the favourable end of the scale. Every component was rated either Good or Excellent, and no component attracted a Fair, Poor or Critical rating. Because the instrument offers a five-point scale of which only the top two levels were used, the ratings carry little discriminating power: they establish that the respondents regard the assessed asset base as sound, but they do not differentiate the relative condition of components within it. The finer-grained defect items in B.2, rather than the summary rating in B.1, therefore carry most of the usable information in this section.

The second feature is an internal inconsistency between the summary rating and the underlying observations for CP-7. The Bridge Structure is the only component in the sample carrying moderate cracking of 1.0 mm to 5.0 mm, which is the highest defect severity recorded anywhere in the assessment; it is nevertheless the component rated Excellent. The respondent's annotation resolves the apparent contradiction — the Excellent rating was applied to the steel superstructure and the concrete plinths were separately described as being in good condition — but the effect is that the single most significant defect observation in the dataset is attached to the most favourable summary rating. Any subsequent use of B.1 as a standalone condition indicator would systematically understate the condition of this component, and B.1 should therefore be interpreted alongside B.2 rather than in place of it.

Substantively, the defect pattern is coherent and points to moisture and biological growth rather than to structural distress. Vegetation growth was recorded on five of the eight components, and the CP-6 free-text entry attributes it to accumulated soil and dust, which is a housekeeping and drainage condition rather than a structural one. Water intrusion appears on three components, in its most advanced form at CP-6, where mold and algae growth was recorded between viaducts. Surface corrosion is confined to two components and no section loss was reported anywhere. Settlement was recorded as minor and observable on two components, and in the one case where a cause was given the respondent attributed it to construction at Guadalupe rather than to in-service loading.

Taken together, the physical condition results describe an asset base that is structurally sound but exhibits the moisture-related surface deterioration characteristic of a continuously exposed elevated alignment in a humid tropical environment. That deterioration is concentrated where water is retained rather than shed — between viaducts, at plinths and in areas of accumulated debris — which links the Section B observations directly to the drainage findings reported in Section 4.4.1.

4.4 Section C — Specific Climate Vulnerability Indicators

Section C records responses to fifteen indicator items across four hazard groups, followed by an overall vulnerability rating. Responses are disaggregated by material. In the tables that follow, a single entry indicates that the concrete and steel columns agreed or that only one column was applicable and completed; where the two columns diverge, the entry is given as “concrete / steel”. A dash indicates that the item was left blank.

4.4.1 C1 — Flood Risk Assessment

Table 6. Responses to the C1 flood risk indicators

Indicator	CP-1	CP-2	CP-3	CP-4	CP-5	CP-6	CP-7	CP-8
C1.1 Located in a known flood-prone area	N	Y / N	Y	N	Y / N	N	N	N
C1.2 Has experienced flooding previously	N	Y / N	Y	Y	Y / —	N	N	N
C1.3 Drainage adequate in heavy rainfall	Y	P / —	P	Y	P / —	Y	Y	Y
C1.4 Observable blockages or inefficiencies	N	Y / —	Y	Y	N	N	N	N

Y = yes; N = no; P = partially; — = left blank. Recorded flood frequency was “Occasionally” in every instance in which the frequency item was answered.

Table 7. Free-text entries recorded against the C1 indicators

Code	Item	Entry as recorded
CP-2	C1.1 / C1.2	“Some stations” (flood-prone); “Station 2” (previously flooded)
CP-2	C1.4 description	“Drainage system along EDSA (station 2) needs to increase or re-study by concerned LGU/dept.”
CP-2	C1.5 elevation	est. 0.5 m relative to historical flood levels
CP-3	C1.1 / C1.2	“Some stations” (flood-prone); “Station 2” (previously flooded)
CP-4	C1.2 depth	“Station 2 only, approx. 1 m”; C1.4 description: “EDSA”
CP-5	C1.1 / C1.2	“Ayala” for both items; approximate flood depth 1 m
CP-6	C1.2 / C1.5	“No experienced flooding, but near Pasig River”; elevation est. 0.5 m

Discussion of the C1 results

Flood exposure emerges from the assessment as spatially concentrated rather than systemic. Four of the eight components record previous flooding, and the free-text entries locate that flooding at two places: the station identified on the forms as “Station 2,” which recurs across CP-2, CP-3 and CP-4, and Ayala, identified on CP-5. Where depth was recorded it is approximately 1.0 m, and where frequency was recorded it is “Occasionally” in every case. No component reports annual or biennial flooding. The station designations should be cross-referenced against the official station naming before publication, since the forms use numeric designations only.

The drainage responses are the most operationally significant result in this group. No component recorded drainage as inadequate outright, but three of the eight recorded it as only partially adequate during heavy rainfall — and those three, CP-2, CP-3 and CP-5, are precisely the components that also report previous flooding. Three components likewise recorded observable blockages or inefficiencies in local drainage. The correspondence between partial drainage adequacy, observable blockage and recorded flood history is consistent across the sample and constitutes the clearest internal validation in the dataset: the flood exposure reported by the respondents is attributed by those same respondents to drainage capacity rather than to any deficiency of the rail structure itself.

The CP-2 free-text entry makes the institutional dimension of that finding explicit. The respondent identifies the drainage system along EDSA as requiring increase or re-study “by concerned LGU/dept.” The flood exposure of the assessed components is therefore attributed, by the operator's own personnel, to infrastructure outside the operator's control. This is a boundary condition of considerable importance: measures confined to the rail asset alone cannot fully address the exposure identified in the assessment, because the governing hydraulic capacity is vested in another agency.

A second point concerns CP-6. The respondent recorded no experienced flooding but volunteered the qualifier “near Pasig River,” together with an elevation of approximately 0.5 m relative to historical flood levels. A negative flood history combined with proximity to a major watercourse and a modest freeboard describes latent rather than absent exposure, and this component should not be grouped with the components that are genuinely remote from flood sources.

4.4.2 C2 — Seismic Risk Assessment

Table 8. Responses to the C2 seismic risk indicators

Indicator	CP-1	CP-2	CP-3	CP-4	CP-5	CP-6	CP-7	CP-8
C2.1 In an area of high seismic activity per national maps	N	N	N	N	Y	N	Y	N
C2.2 Visible signs of past seismic stress	N	N	N	N	Y / N	Y	N	N
C2.3 Seismic retrofitting measures evident	N	N	N	N	N	Y	N	N
C2.4 Proximity to active fault lines	N	N	N	N	N	—	—	N

CP-6 annotated C2.2 with “settlement due to construction,” C2.3 with “retrofitting, yes. applied micropiles,” and C2.4 with “Not known.”

Discussion of the C2 results

The seismic results contain the most consequential divergence in the assessment. Six of the eight components were recorded as not located in an area of high seismic activity based on national maps. Metro Manila is traversed by the West Valley Fault and the entire MRT-3 alignment lies within the metropolitan area, so this response cannot be reconciled with published national seismic hazard mapping. Two readings are available and the assessment cannot adjudicate between them. The item may have been interpreted narrowly, as asking whether the specific component has been affected by seismic activity rather than whether it lies within a mapped high-hazard zone; alternatively, national seismic hazard information may not be embedded in the operational and maintenance awareness of the personnel completing the forms. Either reading is a substantive finding, and the second would be the more serious of the two.

The retrofitting results point the same way. Seven of the eight components record no evident seismic retrofitting measures. The single exception is CP-6, the Elevated Structure at Guadalupe, where the respondent recorded retrofitting with the annotation that micropiles had been applied. That is a foundation intervention rather than a seismic isolation or damping system of the kind the item names, and the free-text entry attributes the underlying movement to settlement during construction. Read strictly, the assessment records no base isolators or dampers anywhere on the assessed portion of the line.

Visible signs of past seismic stress were recorded on two components. In both cases the associated free text points away from seismic causation — CP-6 attributes the observation explicitly to construction settlement. There is accordingly no evidence in the dataset of in-service seismic damage, which is consistent with the absence of a major near-field earthquake during the components' service life rather than with demonstrated seismic adequacy.

The proximity item, C2.4, produced no usable distance data. The item requests a distance in metres but the response format offers only Yes, No and Not Applicable, and the responses are correspondingly binary. Where the respondent had something to say — CP-6, “Not known” — the answer confirms that the information was not available. Fault proximity for the alignment will therefore need to be established from PHIVOLCS mapping rather than from this instrument.

4.4.3 C3 — Extreme Temperature Fluctuation Risk

Table 9. Responses to the C3 extreme temperature indicators

Indicator	CP-1	CP-2	CP-3	CP-4	CP-5	CP-6	CP-7	CP-8
C3.1 Prolonged exposure to direct sunlight and high temperature	N	Y	Y	N	Y	Y	Y	N
C3.2 Visible degradation from thermal expansion or contraction	N	—	—	N	N	N	Y / N	N
C3.3 Incorporates thermal expansion joints	Y	Y	N	N	Y	Y	—	N
C3.4 (as printed: wind bracing adequacy)	—	—	—	—	—	—	—	B

CP-2 and CP-3 annotated C3.2 with the word “maybe” rather than selecting a response. Item C3.4 reproduces the wording of C4.3 under the temperature heading; see Section 4.6.

Discussion of the C3 results

Five of the eight components were recorded as subject to prolonged exposure to direct sunlight and high temperature. The three exceptions are CP-1 Track Section, CP-4 Power Infrastructure and CP-8 Tunnel Section. The last of these is self-explanatory, and CP-4 was annotated elsewhere on the form as being located inside the station, which accounts for its negative response. The negative response for CP-1, the elevated track section at Ayala, is less easily explained, since an elevated ballastless track along the central reservation of EDSA is by configuration among the most continuously insolated components on the line. This response is inconsistent with the affirmative responses returned for the Elevated Structure and the Bridge Structure on the same alignment.

Visible thermal degradation was recorded on only one component, the concrete elements of CP-7, and was not recorded anywhere in steel. Two components returned neither an affirmative nor a negative response, the respondents writing “maybe” instead. That qualifier is itself informative: it indicates that the respondents did not consider themselves able to answer the item from available records, which is consistent with thermal performance not being a routinely monitored parameter.

The expansion-joint responses are mixed and, in one case, notable. Four components record thermal expansion joints as incorporated and three record them as absent. The absence is unremarkable for CP-3 Drainage System and CP-4 Power Infrastructure, for which the item has limited application, but CP-8 Tunnel Section records no expansion joints, and CP-7 Bridge Structure — a steel bridge, for which expansion provision is a standard design requirement — left the item blank. The blank response should not be read as an absence of joints; it should be treated as a data gap requiring verification against the as-built drawings.

C3 is, overall, the least completely answered indicator group in the assessment. Of thirty-two possible responses across the four items, eleven were left blank or qualified. The pattern of non-response is concentrated in the two items that ask about observed thermal effects and about design provision for them, rather than in the item asking about exposure — respondents were able to say that components are exposed to heat, but not what that exposure has produced or what provision exists against it.

4.4.4 C4 — Wind and Typhoon Exposure

Table 10. Responses to the C4 wind and typhoon exposure indicators

Indicator	CP-1	CP-2	CP-3	CP-4	CP-5	CP-6	CP-7	CP-8
C4.1 Highly exposed to strong winds	N	Y	N	N	Y	Y	Y	N
C4.2 Signs of wind-induced damage	N	—	N	N	N	N	N	N
C4.3 Wind bracing or aerodynamic features adequate	Y	Y	N	N	Y	Y	N/A	N/A

CP-2 annotated C4.2 with “maybe.” CP-6 annotated C4.3 with “Yes.”

Discussion of the C4 results

No component in the assessment recorded any sign of wind-induced damage. Seven of the eight returned an explicit negative and the eighth returned the qualifier “maybe.” Given that the line has been in service through repeated tropical cyclone seasons since 1999, this is a substantive result: the assessed components have not sustained observable wind damage, and wind is not, on the evidence of this instrument, a manifested source of physical deterioration on MRT-3.

Wind exposure itself was recorded affirmatively for four components — the Station Building, the overhead catenary system, the Elevated Structure and the Bridge Structure — and negatively for four, comprising the Track Section, the Drainage System, the station-internal power equipment and the Tunnel Section. The negative responses for CP-3 and CP-8 follow from their configuration. The negative response for CP-1 does not: an elevated track section is, by the instrument's own example wording, among the configurations the item is designed to capture, and it sits on the same viaduct as CP-6 and CP-7, both of which returned affirmative responses. As with C3.1, this indicates variation in how individual respondents interpreted exposure items rather than genuine variation in the physical exposure of adjacent components.

The adequacy responses are more difficult to interpret. Four components record wind bracing or aerodynamic features as adequate, two record them as inadequate, and two record the item as not applicable. The two inadequate responses attach to CP-3 and CP-4, components for which wind bracing has limited relevance, while the two not-applicable responses attach to CP-7 and CP-8. The item appears to have been read differently by different respondents — in some cases as a judgement on provision that exists, in others as a statement that no such provision exists or is required — and the responses should not be aggregated into a single adequacy measure without clarification.

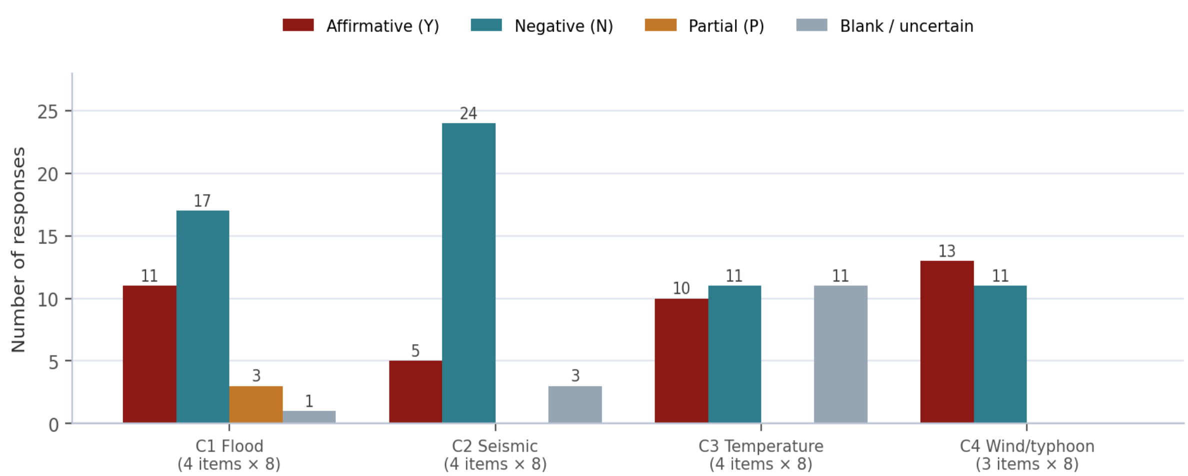

Figure 2. Distribution of affirmative, negative, partial and unanswered responses by climate vulnerability indicator group.

4.4.5 C5 — Overall Vulnerability Rating

Item C5 asks the respondent to assign a single overall vulnerability rating for the component on a four-point scale, taking all climate indicators into account. Seven of the eight components were rated Low (1). One component, CP-6 Elevated Structure at Guadalupe, was rated Moderate (2) for its concrete elements. No component was rated High (3) or Critical (4). The arithmetic mean of the eight ratings is 1.13.

Table 11. Overall vulnerability ratings and recorded justifications (Item C5)

Code	Component	Rating	Justification as recorded
CP-1	Track Section	1 — Low	No justification entered
CP-2	Station Building	1 — Low	No justification entered
CP-3	Drainage System	1 — Low	No justification entered
CP-4	Power Infrastructure (electrical)	1 — Low	“Inside the Station”
CP-5	Overhead catenary system	1 — Low	“Balanced weight installed. Foundations are secured.”
CP-6	Elevated Structure	2 — Moderate	“Since Guadalupe bridge and elevated structures are prone to settlement due to river passage, moderate risks can be considered. Consistent monitoring and maintenance shall be applied to prolong life expectancy.”
CP-7	Bridge Structure	1 — Low	“Inside the Station”
CP-8	Tunnel Section	1 — Low	No justification entered

Discussion of the C5 results

The overall ratings are, like the Section B condition ratings, compressed at the favourable end of the scale, and for the same reason they carry limited discriminating power. More importantly, the summary ratings are not fully consistent with the item-level responses that are supposed to inform them. Four of the eight components report previous flooding to a depth of approximately one metre, three report drainage that is only partially adequate during heavy rainfall, and three report observable blockages in local drainage; yet every one of those components was rated Low overall. A rating scheme in which a component with a metre of recorded flood history returns the same overall score as a component with no flood exposure at all is not resolving the variation that its own indicator items have captured.

The single Moderate rating is instructive in this connection. CP-6 is not the component with the worst recorded defects, nor is it among the components reporting flood history. It is, however, the only component in the sample for which a structural intervention was recorded (micropiles), one of only two with an inspection within the preceding twelve months, and the component whose respondent supplied the most detailed free-text commentary anywhere in the dataset. The Moderate rating appears to reflect the respondent's specific, recent, documented knowledge of a known and monitored condition rather than a greater absolute level of risk.

The corollary follows directly. Components rated Low may be genuinely low in vulnerability, or they may be components about which less is currently known. The three components carrying no inspection record — CP-2, CP-3 and CP-8 — were all rated Low, and none carried any justification text. The C5 ratings should therefore be treated as an index of assessed and documented risk rather than as an index of actual risk, and they should be triangulated against the instrumented and documentary evidence rather than used as a standalone vulnerability measure.

4.5 Synthesis of Assessment Results

Read across its three sections, the assessment produces five consolidated findings.

Finding 1: The assessed asset base is structurally sound but exhibits pervasive moisture-related surface deterioration

No component was rated below Good in overall condition and no severe or propagating cracking, section loss or functionally significant settlement was recorded anywhere. Against that, vegetation growth appears on five of eight components, water intrusion on three, and surface corrosion on two. The deterioration recorded is of a type produced by retained moisture and accumulated debris on continuously exposed surfaces, and it is concentrated at plinths, between viaducts and in areas of soil and dust accumulation.

Finding 2: Flood exposure is real, spatially concentrated, and attributed to drainage capacity outside the operator's control

Half of the assessed components report previous flooding, consistently at approximately one metre and consistently at an occasional frequency, and consistently at two identified locations. The respondents attribute the exposure to drainage adequacy rather than to the rail structure, and one respondent explicitly assigns responsibility for the governing drainage infrastructure along EDSA to the local government unit and concerned department. Flood exposure on MRT-3, as recorded by this instrument, is therefore a boundary problem rather than an internal asset problem.

Finding 3: Seismic hazard is not reflected in the operational assessment

Six of eight components were recorded as not located in a high seismic activity area notwithstanding the alignment's location within Metro Manila; seven of eight record no evident seismic retrofitting; and the fault-proximity item returned no usable data, with the one substantive annotation reading “Not known.” Whether this reflects narrow interpretation of the item or a genuine gap in hazard awareness, the assessment provides no basis for characterising the seismic vulnerability of the assessed components.

Finding 4: Thermal performance is the least documented hazard domain

Eleven of thirty-two possible responses in the C3 group were left blank or qualified with “maybe,” the highest non-response rate of any indicator group. Respondents were consistently able to answer whether a component is exposed to prolonged heat but frequently unable to answer what that exposure has produced or what design provision exists against it. Notably, a steel bridge structure left the expansion-joint item unanswered.

Finding 5: Summary ratings under-discriminate relative to the item-level data that inform them

Both the Section B condition ratings and the Section C overall vulnerability ratings occupy only the top of their respective scales, and in several instances a summary rating is inconsistent with the underlying observations — most clearly at CP-7, where the highest recorded defect severity coincides with the most favourable condition rating, and across the flood-affected components, all of which were rated Low overall. The disaggregated item responses in B.2 and C1–C4 are substantially more informative than either summary rating and should be the basis of subsequent analysis.

Table 12. Consolidated vulnerability profile by component

Code	Component	Condition (B.1)	Flood history	Rating (C5)	Principal issue recorded
CP-1	Track Section	Good	None	1 — Low	Corrugation and stamping; minor settlement
CP-2	Station Building	Good	Yes (Station 2)	1 — Low	Partial drainage adequacy; blockages along EDSA; no inspection record
CP-3	Drainage System	Good	Yes (Station 2)	1 — Low	Partial drainage adequacy; blockages; no inspection record
CP-4	Power Infrastructure (electrical)	Excellent	Yes (Station 2, ~1 m)	1 — Low	Flooding of station-internal power equipment; paint fading
CP-5	Overhead catenary system	Good	Yes (Ayala, ~1 m)	1 — Low	Partial drainage adequacy; minor cracking at supports
CP-6	Elevated Structure	Good	None (near Pasig River)	2 — Moderate	Settlement; mold and algae between viaducts; micropile retrofit applied
CP-7	Bridge Structure	Excellent (steel)	None	1 — Low	Moderate cracking at concrete plinths before the steel bridge
CP-8	Tunnel Section	Good	None	1 — Low	Damp patches; surface rust; no expansion joints; no inspection record

4.6 Data Considerations and Instrument Observations

Several characteristics of the dataset and of the instrument itself qualify the interpretation of the foregoing results and should be reported alongside them.

- Sample size and coverage. Eight forms were returned, one per component category. The results describe eight components and cannot be generalised to the population of components of each type along the line. Where a form records a line-wide scope — CP-2 and CP-3 both cover the stretch of EDSA from North Avenue to Taft Avenue — the responses represent an aggregate judgement across many physical assets rather than an observation of a single one.
- Self-reported and single-rater data. Every entry is a self-report by operator personnel based on visual inspection. No item was independently verified, no inter-rater reliability check was possible because each component was assessed once, and no measurements corroborate the recorded severities. Differences between components may therefore reflect differences between respondents rather than differences between assets, and the divergent exposure responses for CP-1 relative to CP-6 and CP-7 are consistent with that possibility.
- Blank cells are ambiguous. The two-column concrete and steel format produces blanks whenever a component is of a single primary material, but blanks also occur where a respondent was unable or unwilling to answer. The instrument provides no means of distinguishing “not applicable” from “not known,” and blanks have accordingly been reported as blanks rather than recoded.
- Item C3.4 is misprinted. The item printed under the extreme temperature heading reads “Are existing wind bracing or aerodynamic features adequate?”, duplicating the wording of C4.3. It was answered on only one of the eight forms. No temperature-related response can be recovered from this item, and it should be corrected before any further administration of the instrument.
- Item C2.4 mismatches its response format. The item requests proximity to active fault lines expressed in metres but offers only Yes, No and Not Applicable as responses. It returned no distance data on any form.
- Ceiling effects in both rating scales. Item B.1 used only two of five available levels and item C5 only two of four. Neither summary scale produced usable variance, and statistical treatment of either as an interval measure would not be defensible on this dataset.
- Unverified location designations. Flood-affected locations are recorded numerically as “Station 2” without a corresponding station name. These designations should be cross-referenced against official MRT-3 station nomenclature before the finding is reported in final form.
- Absence of respondent identification. The name, department, designation and date fields at the head of each form were left blank on all eight returns. The professional background of the assessors cannot therefore be characterised, which limits any weighting of responses by expertise.

None of these considerations invalidates the substantive findings reported in Sections 4.2 through 4.5. They do, however, indicate that the assessment is best used as a structured record of operator knowledge and of the boundaries of that knowledge, rather than as an independent measurement of physical vulnerability. Where the assessment records an absence — of seismic hazard awareness, of thermal monitoring data, of inspection records for the station buildings, the drainage system and the tunnel section — that absence is itself among the more robust results the instrument has produced.