

Guidance Manual on Investigation of Case of Metal Exceedance Found in Drinking Water



Water Supplies Department

Contents

	<u>Page No.</u>
1. INTRODUCTION	1
2. QUALIFIED CONSULTANT/PERSON	2
3. GENERAL PRINCIPLES OF INVESTIGATION	2
4. PRELIMINARY INVESTIGATION	3
5. DETAILED INVESTIGATION	3

Appendices

Appendix 1 – General Procedures of Preliminary Investigation (PI)

Appendix 2 – Typical Sketches for Investigation

Appendix 3 – Flowchart of PI

Appendix 4 – Investigation Checklist for PI

Appendix 4a-g – Examination scheme (Visual inspection/NDT investigation)

Appendix 4h – Water sampling scheme

Appendix 5 – Visual Inspection Checklist for PI

Appendix 6 – General Procedures of Detailed Investigation (DI)

Appendix 7 – General Guideline for Investigating Other Floors of a Building

Appendix 8 – Flowchart of DI

Appendix 9 – Investigation Checklist for DI

Appendix 10 – Visual Inspection Checklist for DI

Appendix 11 – Report Template

1. INTRODUCTION

- 1.1 Under the Enhanced Water Quality Monitoring Programme (“Enhanced Programme”) of the Water Supplies Department (WSD), a total of about 670 water samples will be randomly taken in the territory each year. If there is exceedance of the respective standards¹ of the six metal parameters² in the 2-tier water samples³ collected from a consumer’s drinking tap at a premises (“the affected premises”), in addition to providing necessary advice on the mitigation measures and health message to the Registered Consumer (“RC”)/owner/occupier of the affected premises, WSD will undertake a preliminary assessment to determine if the exceedance is an isolated case or a suspected non-isolated case (“i.e. exceedance is suspected in other premises within the same building”).
- 1.2 WSD will also adopt a supportive approach by offering the RC of the affected premises an option of having WSD to investigate into the cause of exceedance in the affected premises (“*preliminary investigation*”). Alternatively, the RC can self-engage a qualified person⁴ to conduct preliminary investigation to verify the problem of exceedance and to establish its extent for his/her premises.
- 1.3 In the case of a suspected non-isolated case, the Relevant Parties will be notified and advised to engage a *qualified consultant/person*⁴ to verify the problem of exceedance and to ascertain the extent of the problem in (other premises of) the building (“*detailed investigation*”).
- 1.4 To provide technical assistance to the RC / relevant parties to deal with exceedance cases, WSD has developed the general guidelines of preliminary investigation for an individual premises and detailed investigation for a building for general public’s reference.

¹ The guideline values and provisional guideline values in the World Health Organisation Guidelines for Drinking-water Quality 2011 (“WHO Guidelines 2011”) are adopted as the drinking water standards.

² The six metals are antimony, cadmium, chromium, copper, lead and nickel.

³ The 2-tier water samples include Random Daytime (RDT) and 30-Minute Stagnation (30MS) water samples.

⁴ See Chapter 2 for details.

2. QUALIFIED CONSULTANT/PERSON

- 2.1 A qualified person (QP) is a Building Services Engineer, Building Surveyor or Licensed Plumber who has received training on investigation of excess metal content found in drinking water and passed the examination of relevant training course (e.g. holders of Certificate in Investigation of Excess Metal Content Found in Drinking Water issued by the WSD or equivalent).
- 2.2 A qualified consultant (QC) is a consultant of either Building Services Engineering or Building Surveying category which has at least 2 qualified persons under its employment. A qualified consultant should be engaged for investigation in large scale of building).
- 2.3 WSD maintains the lists of QP and QC which are available at its website for reference by the public.

QP:

http://www.wsd.gov.hk/filemanager/en/content_1732/list-of-qualified-person.pdf

QC:

http://www.wsd.gov.hk/filemanager/en/content_1732/list-of-qualified-consultants.pdf

3. GENERAL PRINCIPLES OF INVESTIGATION

- 3.1 The general principles in conducting investigation are as follows:
- i. There should be **no hard and fast rule** for conducting the investigation and thus **professional judgement** should always be exercised so as to address the particular situation of each individual case;
 - ii. Analysis should be evidence-based in which all relevant information should be obtained and analysed. The relevant information includes but is not limited to the following:
 - ✧ Results of water sampling tests and material check
 - ✧ Brands and models of pipes and fittings used

- ✧ Any alteration works carried out for the plumbing system both inside the concerned premises and in the communal areas
- ✧ Plumbing drawings and records, contractor, subcontractor, licensed plumber etc. engaged for the plumbing work, construction details and records (if available)

4. PRELIMINARY INVESTIGATION

- 4.1 The purposes of preliminary investigation are to ascertain the cause of exceedance in the affected premises for the RC to carry out the rectification works and to provide input to the detailed investigation if it is a suspected non-isolated case in a building.
- 4.2 Relevant information such as any alteration works carried out for the plumbing system, the responsible contractor, subcontractor, licensed plumber etc. shall be obtained if available. In addition, inspection of the plumbing system and material check on the plumbing material shall be conducted. Moreover, upon review of the previous water sampling results, additional water sampling test may be carried out if necessary. Based on the above information and test results, the investigator shall ascertain the cause of exceedance and make recommendation to RC on the rectification works.
- 4.3 If it is a suspected non-isolated case, the findings of the preliminary investigation will also be passed to the Relevant Parties (see paragraph 1.3 above) as reference for the detailed investigation.
- 4.4 Based on the above guidelines, the general procedures (with sketches), flowcharts, checklists for the preliminary investigation are given in **Appendix 1 to 5** for reference.

5. DETAILED INVESTIGATION

- 5.1 The purposes of detailed investigation are to verify the problem of exceedance and to ascertain the extent of the problem in (other premises of) the building. It shall also determine the cause of exceedance and recommend the rectification works.

- 5.2 Similar to paragraph 4.2 for the preliminary investigation, relevant information such as preliminary investigation results, any alteration works carried out for the plumbing system such as any alteration works carried out for the plumbing system, the responsible contractor, subcontractor, licensed plumber etc. shall be obtained if available.
- 5.3 In the circumstance without sufficient information for determining the approach of detailed investigation, the QC/QP may make reference to the following approach of the detailed investigation as a general heuristics:
- 5.3.1 Water samples may first be taken from the fresh/potable water tank(s) for testing to confirm whether the exceedance is caused by the plumbing system within the building.

1st Step: Investigation in neighbouring premises on the same floor and the floors immediately above and below the affected premises

- 5.3.2 30MS water samples may be taken randomly from 20-25% of the neighbouring premises⁵ on the same floor and the floors immediately above and below for testing the concerned metal parameter(s) of exceedance. Those water samples with exceedance shall be followed by material check (for exposed plumbing) or sequential water samples (for concealed plumbing) to determine the cause of exceedance.
- 5.3.3 If no exceedance is found in all the 30MS water samples, it is very likely that the exceedance in the affected premises is an *isolated case*. However, the investigator shall take into account **all available information/evidence** and exercise **professional judgement** to decide whether extending the investigation to other floors of the building is required. Moreover, if exceedance is only found in 30MS water samples taken from the other premises on the same floor of the affected premises but not the floors immediately above and below, it is likely that only an *isolated floor* is affected. Nevertheless, the investigator shall also take into account **all available information/evidence** and exercise **professional judgement** to determine whether extended investigation of other floors in the building is required.

⁵ The number of premises includes the affected premises previously identified. For the floor with 4 premises or less, 1 more premises should be investigated on the same floor while at least 1 premises should be investigated on the floors immediately above and below.

- 5.3.4 If there is exceedance in any of the 30MS water samples taken from the premises on the floors immediately above and below, extended investigation of other floors in the building shall be carried out. Nevertheless, the above extended investigation may not be necessary if the cause, source and extent of exceedance can be concluded for recommendation of rectification works or another protocol (including the number and locations of premises to be further investigated) is found more suitable for extending the investigation to other floors by taking into account all available information/evidence and exercising professional judgement;

2nd Step: Extended investigation of other floors in the building

- 5.3.5 Extended investigation may be carried out by taking water samples at every fifth floor and the most top and bottom floors in the building to determine the extent of exceedance. For each of these floors, 30MS water samples shall be taken randomly from 20-25% premises. Similar to the 1st Step, exceedance shall be followed by material check (for exposed plumbing) or sequential water samples (for concealed plumbing) to ascertain the cause of exceedance.

3rd Step: Further testing and conclusion

- 5.3.6 Based on the results of the water sampling test (and material check, if conducted) of the extended investigation, the investigator should observe the pattern of exceedance in the building. The investigator may carry out further water sampling test and / or material check in other premises and on other floors as appropriate as well as other tests and checking he considers necessary. Based on all the water sampling test results, material check results, information/evidence available, the investigator shall ascertain the cause of exceedance, establish its extent in the building and make recommendation on the rectification works.
- 5.3.7 The above steps are illustrated in **Appendix 7**.
- 5.4 The general procedures (with sketches), flowcharts, checklists for the detailed investigation are given in **Appendix 6 to 10** for reference.

Appendix 1 (Page 1 of 3)**General Procedures of Preliminary Investigation (PI)**

- a) Review of previous water sampling results to identify the concerned metal(s) with excess amount in found in drinking water from the drinking water tap of the concerned premises (see table 1):

Table 1

<u>Parameter (Metals Commonly Found in Pipework)</u>	<u>WHO Guideline Value⁶ (µg/L)</u>
Antimony	20
Cadmium	3
Chromium	50 (Provisional)
Copper	2,000
Lead	10 (Provisional)
Nickel	70

- b) Review of as-fitted plumbing drawings and material records of pipes, valves and fittings used in the premises/building, information on responsible contractor, sub-contractor, licensed plumber and sequence of works and any other relevant information to facilitate visual inspection and on-site testing;
- c) On-site survey of existing plumbing system and its installations when drawings are not available;
- d) Enquiry on any self-alteration of plumbing installation inside the premises, and prolonged stagnation of plumbing system due to unoccupied or infrequent usage to facilitate visual inspection and on-site testing;
- e) Use of table 2 to quickly identify the corresponding possible sources of excess metal leaching from the plumbing components;

⁶ WHO Guideline value represents the levels of antimony, cadmium, copper and nickel in drinking water will not result in any significant health risk to the consumer weighing 60kg over a lifetime consumption of 2 liters of drinking water per day for 70 years.

Appendix 1 (Page 2 of 3)**Table 2**

Metal	Possible Sources in Plumbing Components
Lead	<ul style="list-style-type: none"> ▪ Solder alloy ▪ Copper pipes ▪ Copper alloy fittings, valves ▪ Tapware ▪ Cast iron valves ▪ Galvanized iron pipes and fittings ▪ Non-metallic components
Antimony	<ul style="list-style-type: none"> ▪ Solder alloys ▪ Non-metallic components
Cadmium	<ul style="list-style-type: none"> ▪ Galvanized iron pipes and fittings ▪ Brazing filler metals ▪ Non-metallic components
Chromium	<ul style="list-style-type: none"> ▪ Tapware ▪ Non-metallic components
Nickel	<ul style="list-style-type: none"> ▪ Copper alloy fittings, valves ▪ Tapware ▪ Non-metallic components
Copper	<ul style="list-style-type: none"> ▪ Copper pipes ▪ Copper alloy fittings, valves ▪ Tapware ▪ Non-metallic components

- f) Visual inspection of the plumbing installations (e.g. pipe layout and alignment, pipe materials, locations of valves and fittings, pipe connection methods, water taps, water usage at draw-off points, water filter/strainer at draw-off points etc.) inside the concerned premises and at its inside service to identify any deviations against the plumbing drawings and material record (if available). Particular attention should be given to dead legs of the pipework, dirty strainers, improper connection of water appliances, etc. which are common causes of contamination;
- g) Use of quick in-situ tests for exposed pipework (i.e. X-ray fluorescence (XRF) analyzer for quick detection of concerned metal composition; alternatively, instant test swab for quick detection of lead) to determine possible contamination source(s) in the problematic pipework with the concerned metal contamination problem found;
- h) Taking additional water samples⁷ from drinking water tap(s) for inside service (in particular concealed plumbing) to find out the extent of metal contamination by checking the concerned metal content in water samples in particular pipe sections. The water samples should be tested for the concerned metal parameter exceeding the GV/PGV of WHO water quality standards as identified under the previous investigation of water sampling results;

⁷ For example, water samples include 30MS, sequential and fully flushed (FF) samples. Sequential water samples are sequential 1-litre samples to be taken immediately after the 30MS sample while FF water sample is taken after the tap has been flushed for 5 minutes. The volume to be dependent on the pipe diameter and the pipe length of the pipework (i.e. volume of water inside the pipework/ 1-litre sample). All filters/strainers at water taps attached to the drinking outlet shall be bypassed or removed from the pipework before taking the water sample.

Appendix 1 (Page 3 of 3)

- i) Analysis of findings in the investigation work to ascertain whether the exceedance of metal content is originated from inside service of the individual premises and determine whether it is a suspected non-isolated case (i.e. exceedance is suspected in other premises within the same building), as well as to give an indication on whether the exceedance is confined to the affected drinking water tap or not, in case of premises having multiple drinking water taps, taking into account all available information/evidence;
- j) Analysis of findings in the investigation work to determine (i) the causes and sources of metal contamination as well as the extent of problematic pipework of the premises concerned due to exceedance of metal content originated from inside service of the individual premises and/or (ii) other possible cause(s); and
- k) The qualified person shall prepare report on the investigation work conducted and the results including source and extent of the problem. The qualified person shall recommend rectification works (e.g. replacement of problematic pipework) in the report. Investigation report template is given in **Appendix 11** for reference. The report is to be precise and comprehensive embracing all investigation work carried out by the qualified person.

Notes: An indicative time frame is provided below for QP/QC to systematically follow the general procedures of PI in order to analyze the findings in the site investigation works for making such conclusion for the following buildings:

<u>Premises type</u>	<u>Working days required for site investigation</u>
Domestic	3
School	3
Hospital	5 – 6 (subject to site condition (e.g. complexity and scale of the plumbing system))
Office	3
Shopping mall (include catering)	5 – 6 (subject to site condition (e.g. complexity and scale of the plumbing system))

The suggested timetable is based on the following events:

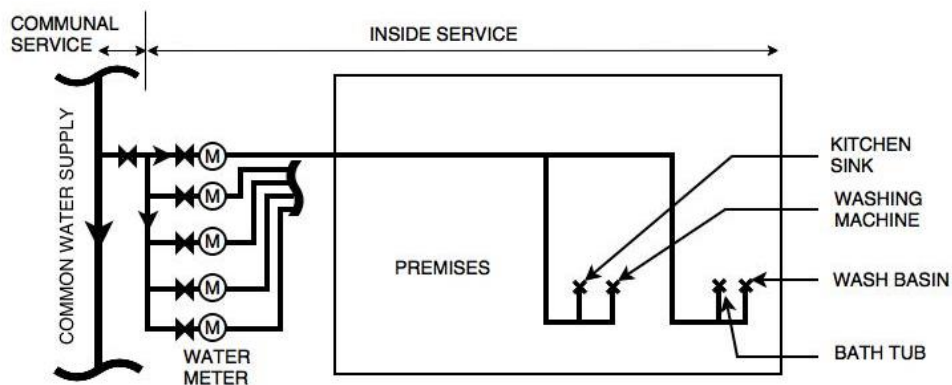
1) The time frame indicated includes 3 days for taking water sample and getting test report from laboratory and examination of pipework in the concerned premises

Remark: The timeframe does not include the preparation and coordination time required, the time required for engagement of the qualified person and the preparation of an investigation report. It is envisaged that 3 more days will be required for the procedures (j) and (k)

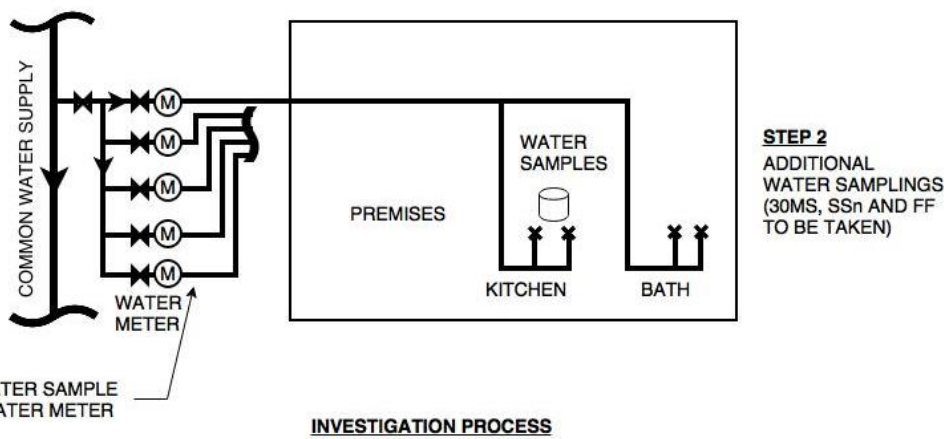
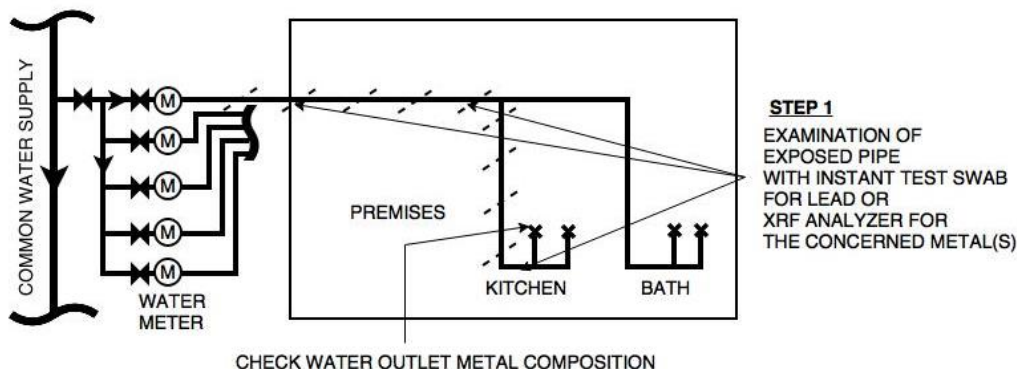
Appendix 2 (Page 1 of 2)

Typical Sketch for Investigation

Sheet 1 – In-premises investigation (for inside service)



DIAGRAMMATIC WATER SUPPLY IN BUILDING

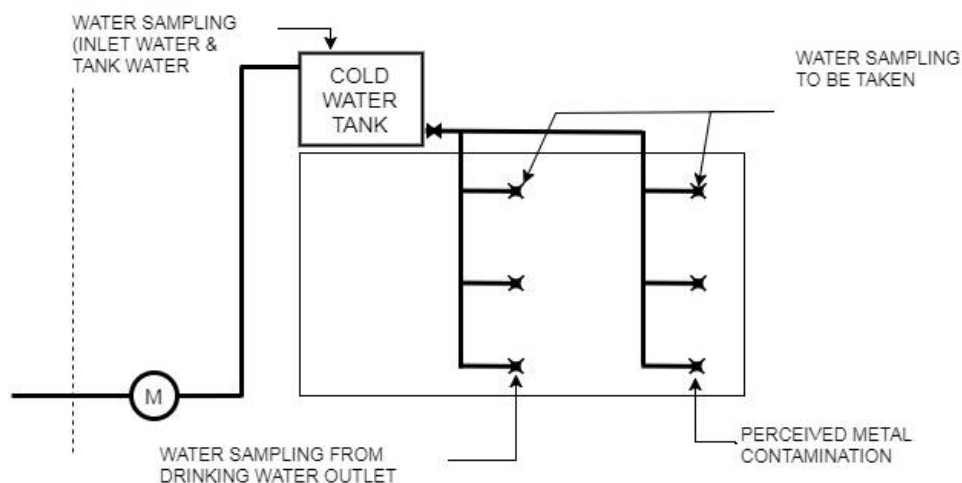
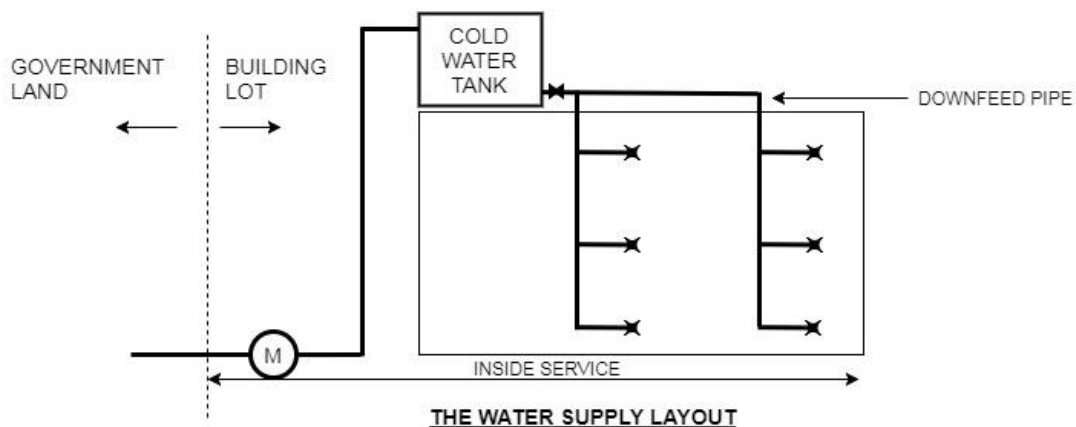


INVESTIGATION PROCESS

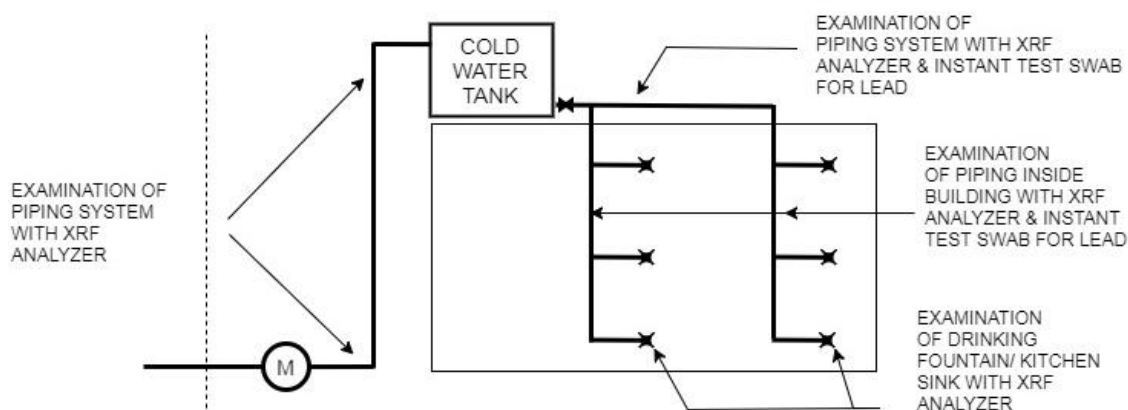
INVESTIGATION RESULTS TO CONFIRM OCCURRENCE OF METAL CONTAMINATION IN DRINKING WATER WITHIN PREMISES BASED ON NON-DESTRUCTIVE TEST

Appendix 2 (Page 2 of 2)

Sheet 2 – Building with a single registered consumer



WATER SAMPLING FOR INVESTIGATION

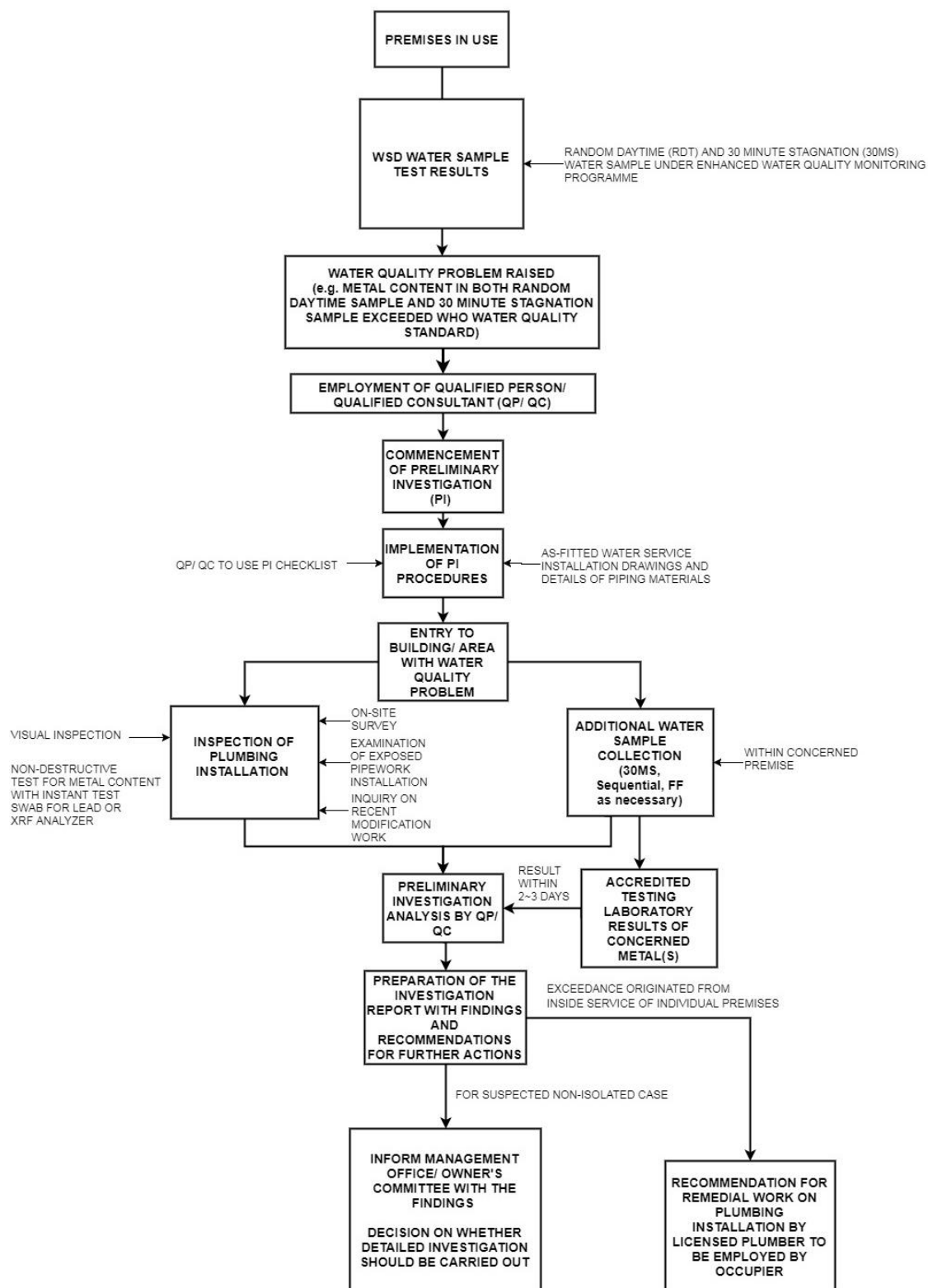


CHECKING METAL CONTENTS IN PIPEWORK FOR INVESTIGATION

1. TAKE WATER SAMPLES FROM SELECTED DRINKING WATER OUTLETS AND INSIDE SERVICE PIPING
2. USE XRF TO CHECK METAL CONTENTS IN DRINKING WATER PIPEWORK
3. IDENTIFY SOURCE & SCALE OF METAL CONTAMINATION AND REPORT TO OWNER FOR RECTIFICATION WORK

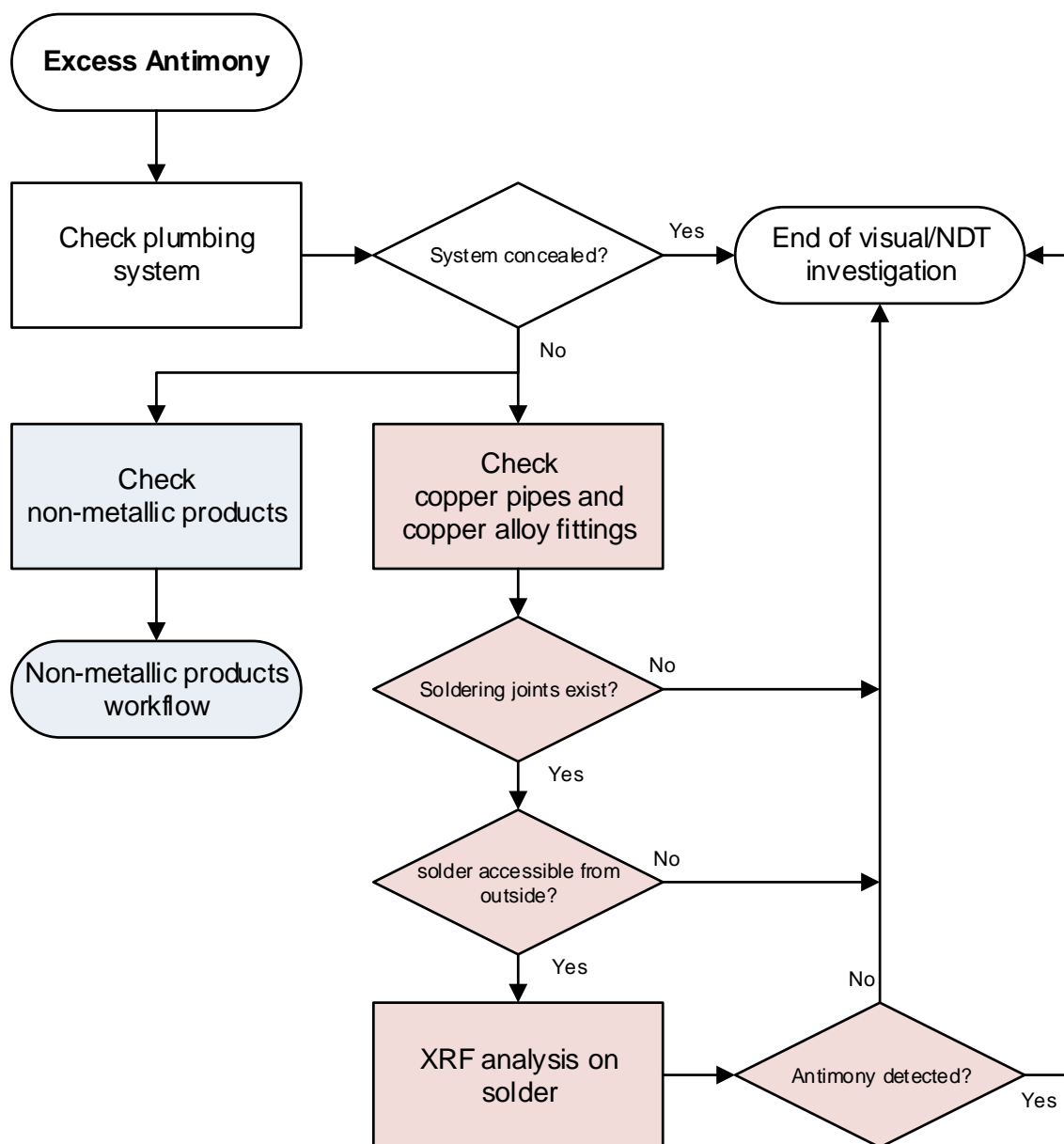
Appendix 3

Flowchart for PI



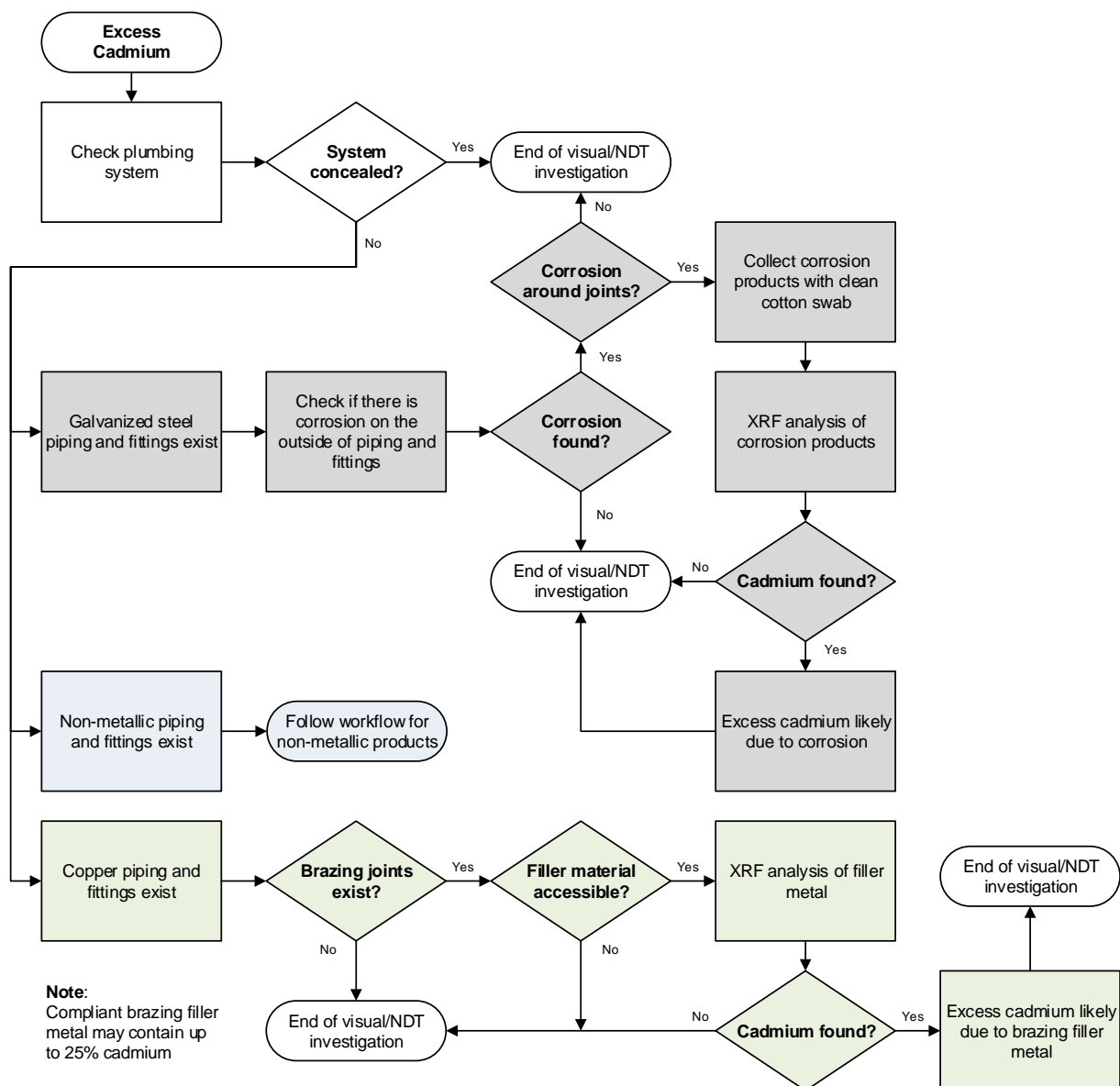
Appendix 4 (Page 1 of 9)**Investigation Checklist for PI**

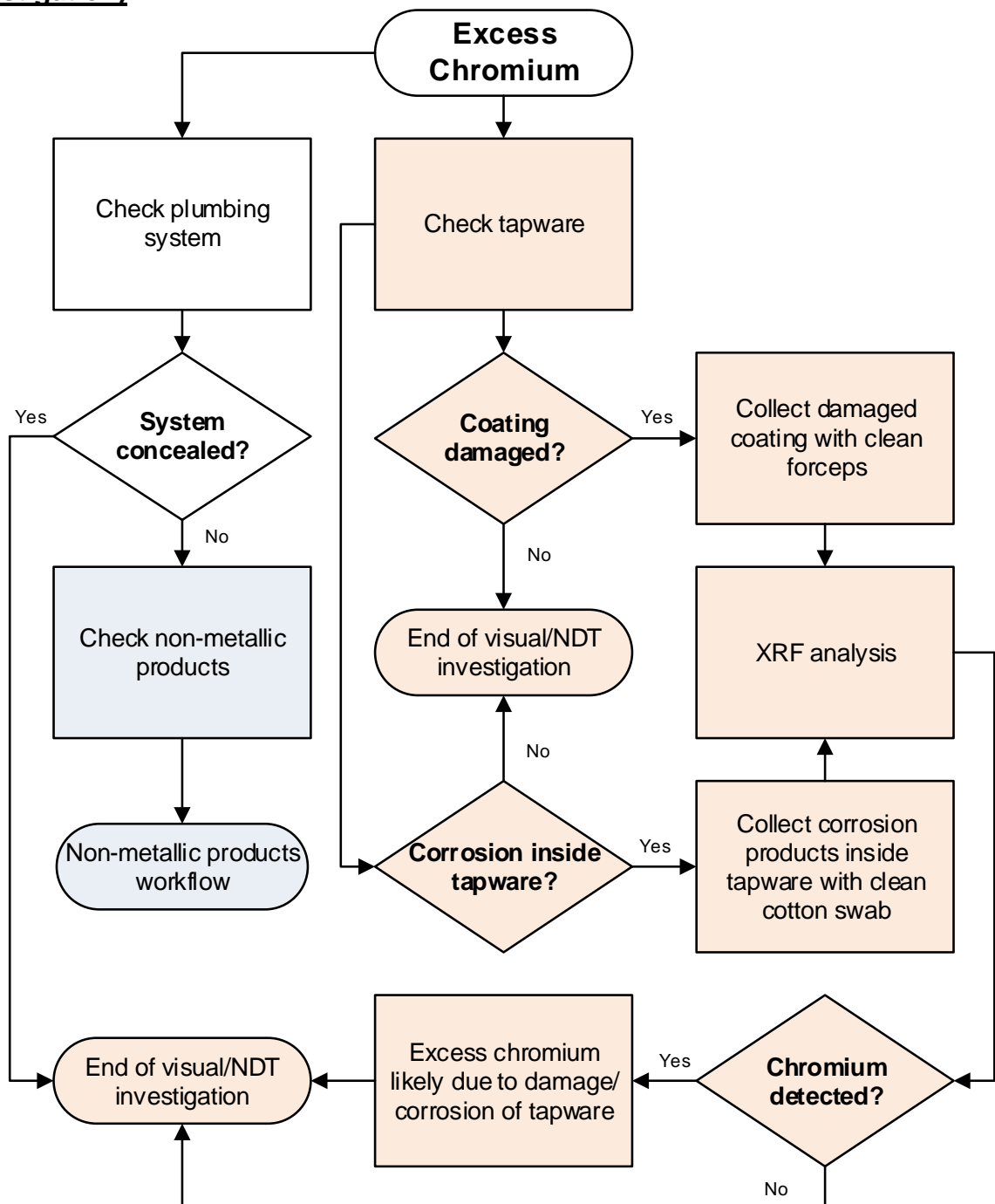
<u>Item</u>	<u>Procedure</u>	<u>Yes</u>	<u>No</u>	<u>Remark</u>
1.	Review of previous test results of water samples	<input type="checkbox"/>	<input type="checkbox"/>	
2.	Desktop review of as-fitted plumbing drawings/site survey if drawings are not available	<input type="checkbox"/>	<input type="checkbox"/>	
3.	Desktop review of material specifications of pipes, fittings, valves used. QP/QC to provide survey, if these are not available	<input type="checkbox"/>	<input type="checkbox"/>	
4.	Enquiry on any modifications to plumbing installation inside premises including piping materials and prolonged stagnation	<input type="checkbox"/>	<input type="checkbox"/>	
5.	Use table 1 'Possible source in approved plumbing components for exceedance of metal contents' to identify possible sources of contaminations (e.g. pipe, fitting, valve)	<input type="checkbox"/>	<input type="checkbox"/>	
6.	Visual inspection of plumbing installation in the concerned premises e.g. pipe layout, arrangement of pipe fittings and valves and connecting pipework to equipment.	<input type="checkbox"/>	<input type="checkbox"/>	
7.	Use of portable X-ray analyzer, instant test swab for lead to identify possible contamination sources for metal detection (for exposed plumbing)	<input type="checkbox"/>	<input type="checkbox"/>	
8.	Take water samples 30MS and, successive stagnant (SSn or called sequential) from the drinking water outlet for further testing on metal contents inside the premises (for concealed plumbing)	<input type="checkbox"/>	<input type="checkbox"/>	
9.	Take fully flushed sample or disconnect the water meter outlet pipe to check the metal content in the communal service	<input type="checkbox"/>	<input type="checkbox"/>	
10.	Preparation of preliminary investigation report to include findings and recommendations on necessary remedial works	<input type="checkbox"/>	<input type="checkbox"/>	

Appendix 4 (Page 2 of 9)**Appendix 4a – Excess antimony examination scheme (Visual inspection/NDT investigation)****Note:**

Compliant solder alloys may contain up to 5.5% antimony

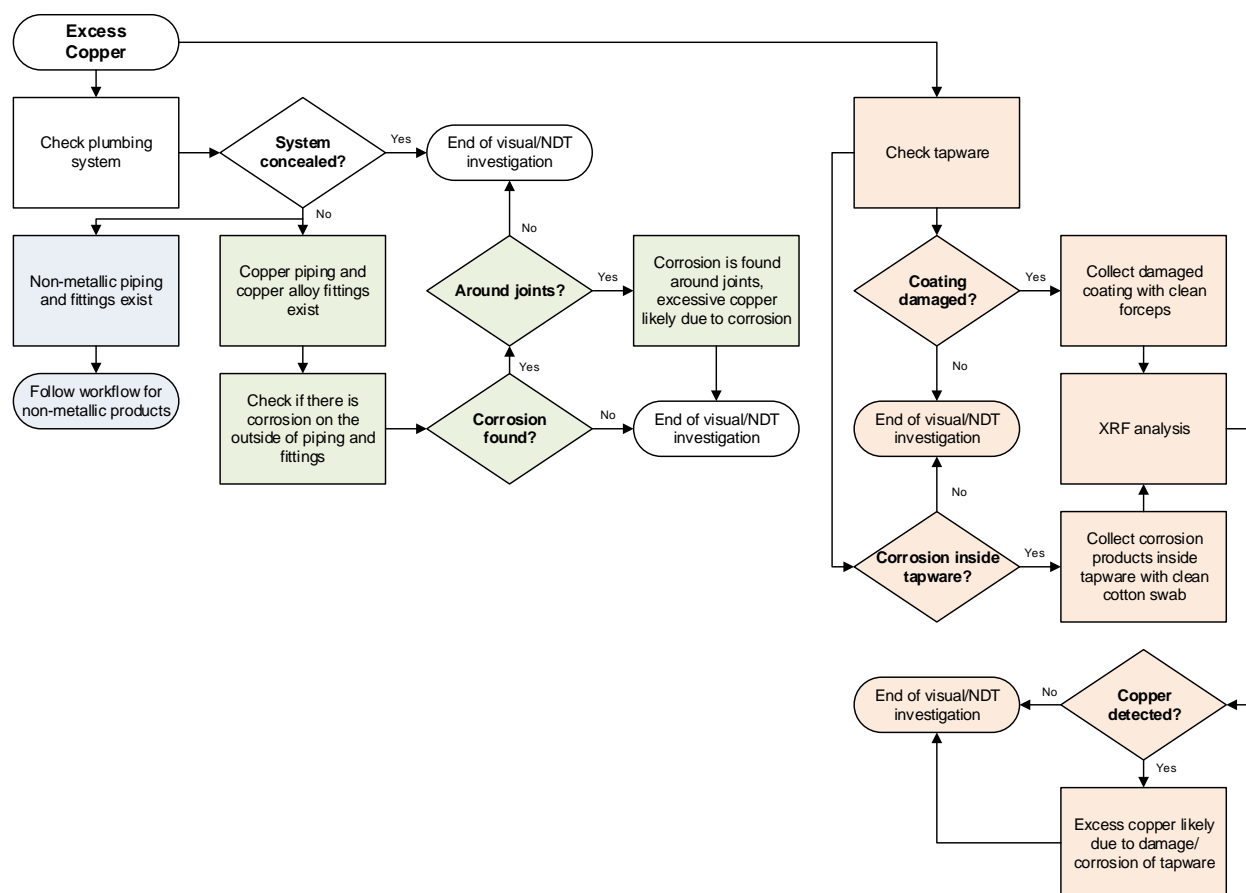
Appendix 4 (Page 3 of 9)

Appendix 4b – Excess cadmium examination scheme (Visual inspection/NDT investigation)

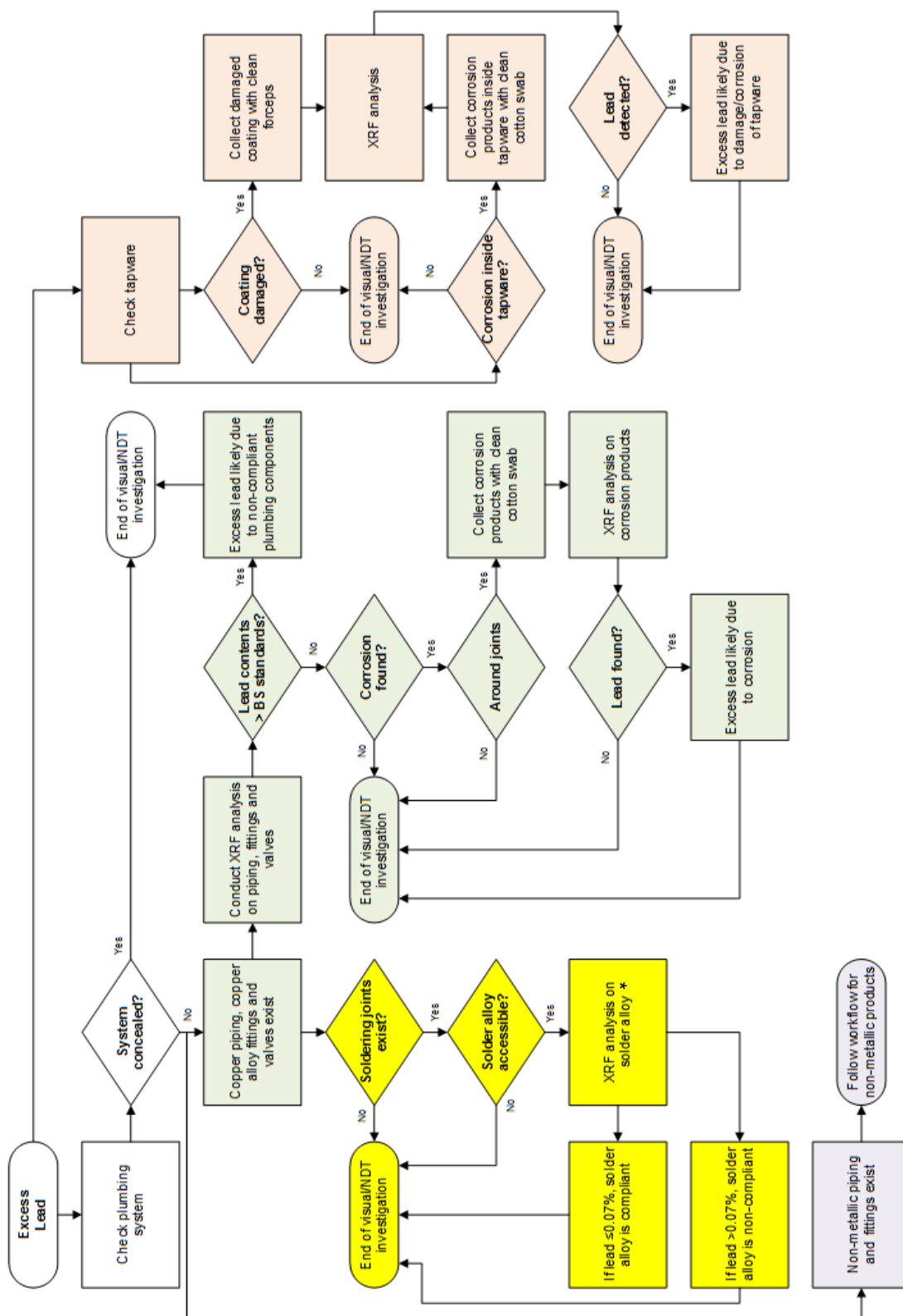
Appendix 4 (Page 4 of 9)**Appendix 4c – Excess chromium examination scheme (Visual inspection/NDT investigation)**

Appendix 4 (Page 5 of 9)

Appendix 4d – Excess copper examination scheme (Visual inspection/NDT investigation)

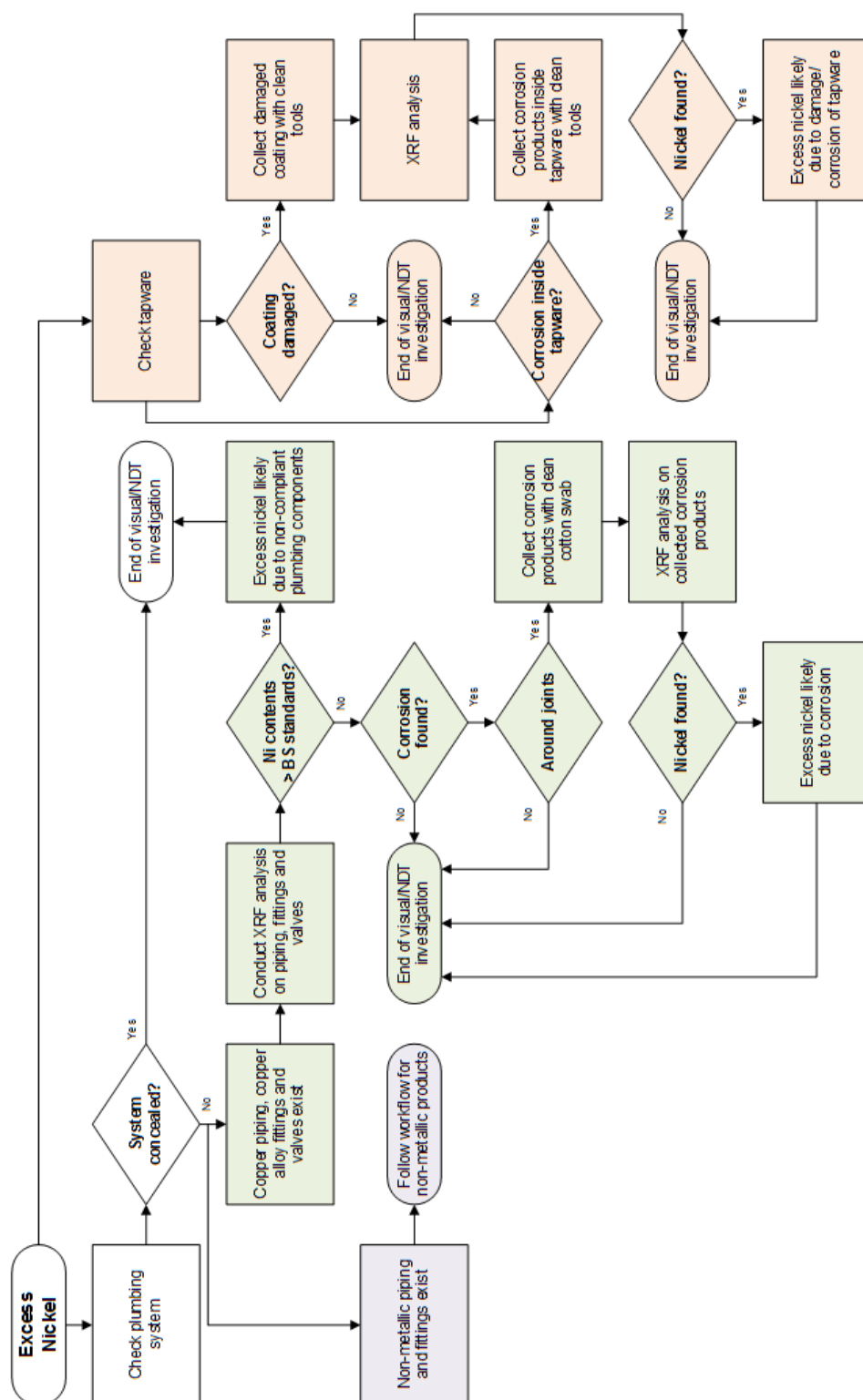


Appendix 4e – Excess lead examination scheme (Visual inspection/NDT investigation)



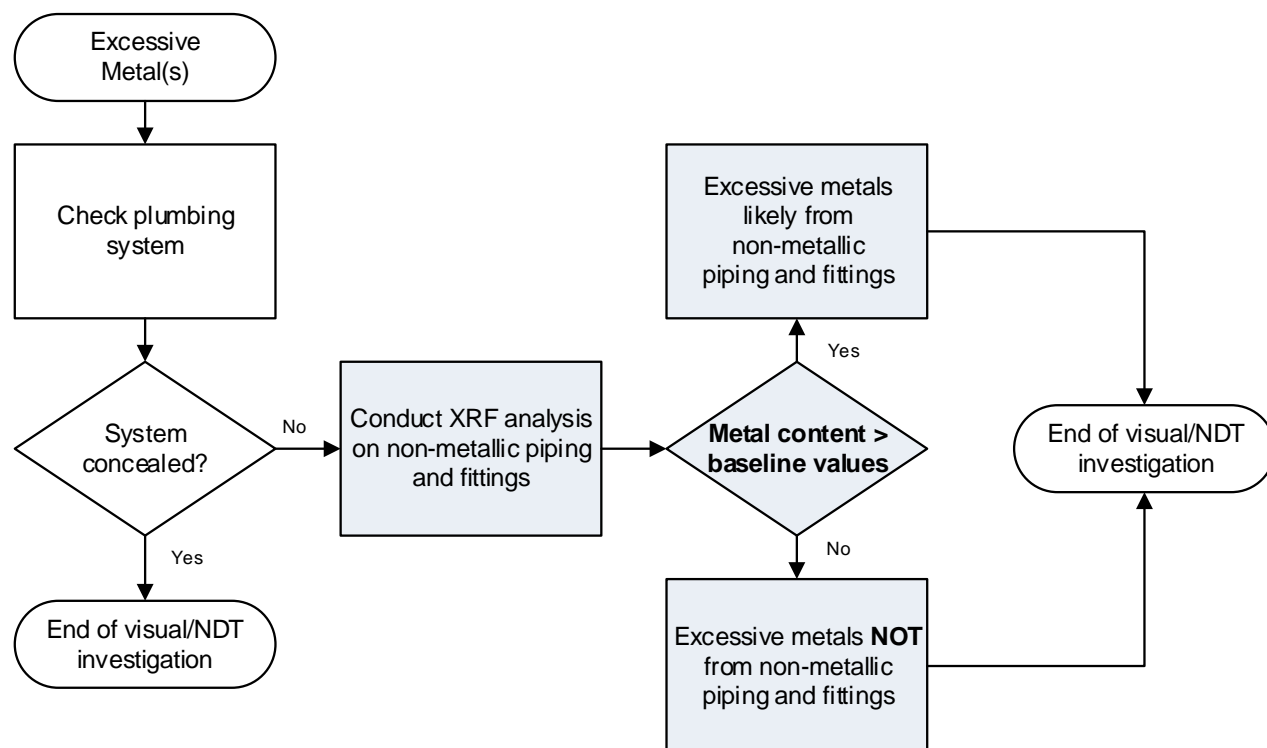
* Alternatively, instant test swab for quick detection of lead can be used.

Appendix 4f – Excess nickel examination scheme (Visual inspection/NDT investigation)



Appendix 4 (Page 8 of 9)

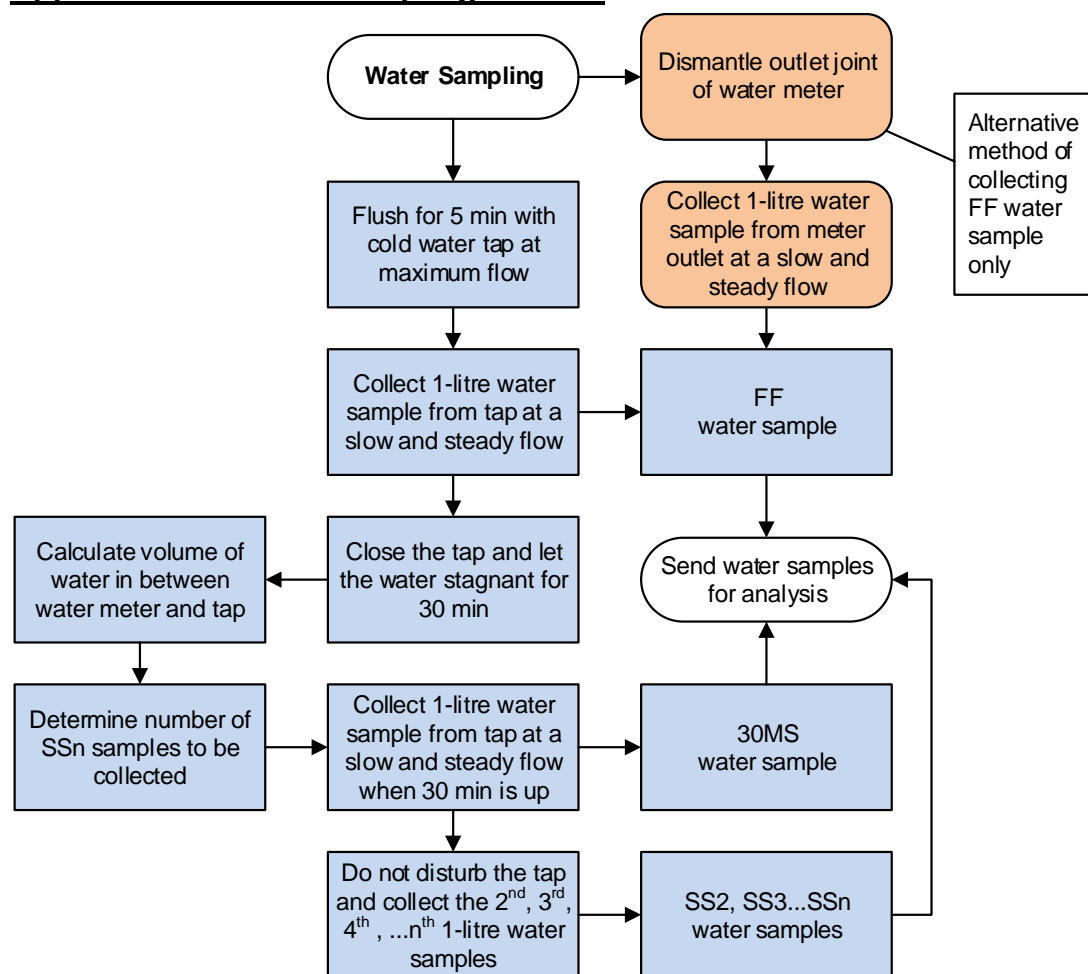
Appendix 4g – Non-metallic products examination scheme (Visual inspection/NDT investigation)



Note:

(1) Antimony, Cadmium, Chromium, Copper, Lead and Nickel in non-metallic products could leach into water.

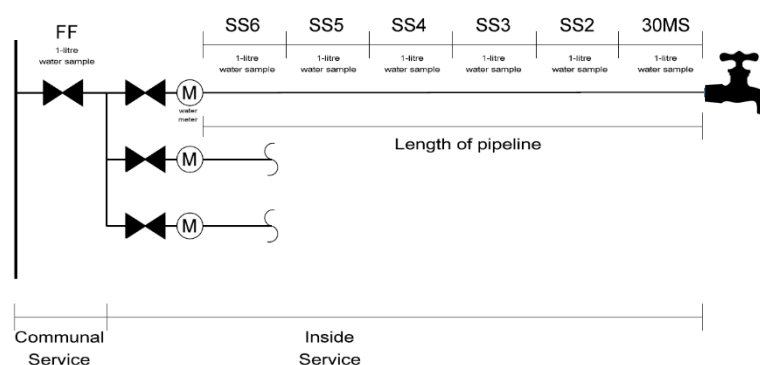
(2) Non-metallic products compliant to BS 6920-1:2014 meet the leaching test requirements of BS 6920-2.6:2000. No maximum allowable metal contents for non-metallic products is available in the relevant BS standards. Assessment of metals being at excessive level or not is by comparing the XRF results against the baseline values of different metals, in particular antimony, cadmium, chromium, copper, lead and nickel, established after having analyzed a sufficient number of BS 6920-1:2014 compliant non-metallic products by XRF.

Appendix 4h – Water sampling scheme

Note:

Fully Flushed (FF) water sample is taken after the tap has been flushed for 5 minutes. The purpose of FF water sample is to check whether the source of excess metal is from the communal service.

30-minute stagnant (30MS) and successive stagnant (SSn) water sample shall be collected from the tap which has been fully flushed and the water inside the plumbing system is stagnated for exactly 30 minutes. 30MS and SSn samples shall be collected continuously without interrupting the flow of the water between samples. Number of SSn water samples depends on the part of inside service after the water meter. The purpose of 30MS and SSn water samples is to identify the extent of the source of excess metal within the part of inside service pipeline after the water meter of the premises. Please see the following illustration of water sampling scheme.



Appendix 5

Visual Inspection Checklist for PI

1. Explanation of purpose of site survey with assistance from building management for entry to water meter room, ceiling voids accommodating the water supply pipe to the concerned premises and the concerned premises
2. Follow water supply drawings, check pipe run from premises' water meter in water meter room to the kitchen water tap
3. When drawings and records of plumbing systems are not available, the qualified person/consultant must carry out a detailed site survey to fully ascertain the piping arrangement before carrying out the investigation
4. Note and record exposed and concealed pipe length on drawing. Note pipe section between exposed and concealed pipe and see whether they are the same
5. Inspect exposed pipe run, material of pipe, pipe jointing method, arrangement of valve and tap. Note any difference between approved and actual installation
6. Note water filter/strainer under kitchen sink (filter/strainer must be removed and supply pipe cleaned for water sampling)
7. Note non-compliant pipework and pipework material
8. Observe any unusual pipe corrosion on pipe surface as this can be one of the sources of excess metal in drinking water

Appendix 6 (Page 1 of 4)**General Procedures of Detailed Investigation (DI)**

[In the circumstance without sufficient information for determining the approach of detailed investigation, the QC/QP may make reference to the following approach of the detailed investigation (including Appendices 7-10) as a general heuristics.]

- a) Review of previous water sampling results including those in preliminary investigation to identify the concerned metal(s) with excess amount in drinking water found;
- b) Review of as-fitted plumbing drawings and material records of pipes, valves and fittings used in the building/within the lot boundary, information on responsible contractor, sub-contractor, licensed plumber and sequence of works, and any other relevant information to facilitate visual inspection and on-site testing;
- c) On-site survey of existing plumbing system and its installations when drawings are not available;
- d) Enquiry on any modifications and maintenance works to plumbing system and its installation inside the building, and prolonged stagnation of the plumbing system due to unoccupied or infrequent usage to facilitate visual inspection and on-site testing and/or possible in-premises investigation and their inside services;
- e) Use of table 2 to quickly identify the corresponding possible sources of excess metal leaching from the plumbing components;

Table 2

Metal	Possible Sources in Plumbing Components
Lead	<ul style="list-style-type: none"> ▪ Solder alloy ▪ Copper pipes ▪ Copper alloy fittings, valves ▪ Tapware ▪ Cast iron valves ▪ Galvanized iron pipes and fittings ▪ Non-metallic components
Antimony	<ul style="list-style-type: none"> ▪ Solder alloys ▪ Non-metallic components
Cadmium	<ul style="list-style-type: none"> ▪ Galvanized iron pipes and fittings ▪ Brazing filler metals ▪ Non-metallic components
Chromium	<ul style="list-style-type: none"> ▪ Tapware ▪ Non-metallic components
Nickel	<ul style="list-style-type: none"> ▪ Copper alloy fittings, valves ▪ Tapware ▪ Non-metallic components
Copper	<ul style="list-style-type: none"> ▪ Copper pipes ▪ Copper alloy fittings, valves ▪ Tapware ▪ Non-metallic components

Appendix 6 (Page 2 of 4)

- f) Visual inspection of the plumbing system and its installations (e.g. system configurations (direct or indirect supply), risers and downfeed pipes layouts and alignments, pipe and water tank materials, locations of water tanks, strainers, valves and fittings, pipe connection methods, dead-legs, water usage at draw-off points, etc.) in common area and plumbing installations and materials (e.g. pipe layout and alignment, pipe materials, locations of valves and fittings, pipe connection methods, water taps, water usage at draw-off points, water filter/strainer at draw-off points etc.) inside the concerned premises and at its inside service to identify any deviations against the plumbing drawings and material record (if available), ;
- g) Taking 30MS water samples⁸ from drinking water taps in neighbouring premises⁹ on the same floor of the concerned premises and the floors immediately above and below the concerned premises with exceedance of certain metal parameter(s) (the number of neighbouring premises plus the concerned premises are about 20%-25% of the premises on that floor) to find out the possible extent of metal contamination by checking the concerned metal content in water samples. The water samples should be tested for the concerned metal parameter(s) exceeding the GV/PGV of WHO water quality standards as identified under the previous investigation water sampling results. Also taking water samples from all fresh/potable water tanks to verify whether the exceedance is sourced from water supply of the building;
- h) Use of quick in-situ tests for exposed pipework (e.g. portable analyzer, i.e. X-ray fluorescence (XRF) analyzer for quick detection of concerned metal composition; alternatively, instant test swab for quick detection of lead) and/or sequential water samples for concealed pipework to determine possible contamination source(s) of the water samples. If conclusion on the cause and extent of exceedance can already be drawn based on the available information/evidence in (a) to (g) above, the above NDT or further water sampling may not be necessary;
- i) The investigator should take into account all available information/evidence and exercise professional judgement to determine whether the metal contamination only affecting an isolated floor can be concluded or the affected premises found is an isolated case if the concerned metal contamination problem is only found in water samples taken from the premises on the original floor but not the floors immediately above and below or no further concerned metal contamination problem is found from any neighbouring premises.

⁸ Fully flushed (FF) water sample is taken after the tap has been flushed for 5 minutes. FF water sample should be taken from any one of the neighbouring premises if the excess metal content in drinking water is found originated from communal service of the building in the previous investigation.

⁹ Neighboring premises are to be investigated (if the samples collected from the concerned premises confirm an issue with excess metal content) as it is likely that they are affected as well. Number of premises to be investigated shall depend on the scale of the building. It is recommended to investigate 20 – 25% of premises served by the same common pipe to review extent of the problem including the affected premises previously identified. For the floor with 4 premises or less, 1 more premises should be investigated.

Appendix 6 (Page 3 of 4)

- j) The investigator should extend the investigation to other floors at 5-floor interval including the most top and bottom floors of the building by taking water samples followed by NDT or sequential water samples from random 20-25% premises for each of these floors to determine the extent of exceedance and to ascertain the cause of exceedance (see **Appendix 7** for illustration), if the concerned metal problem is also identified on the floors immediately above and below the original concerned premises. Nevertheless, the above extended investigation may not be necessary if the cause, source and extent of exceedance can be concluded for recommendation of rectification works or another protocol (including the number and locations of premises to be further investigated) is found more suitable for extending the investigation to other floors by taking into account all available information/evidence and exercising professional judgement;
- k) Possibly carrying out further water sampling test and material check in other premises and on other floors as appropriate as well as other tests and checking if considered necessary based on the results of the findings of 30MS water sampling test and material check carried out in (i) and (j) and pattern of exceedance;
- l) Analysis of findings in the investigation work to determine the potentially affected zones due to the exceedance of metal content in the affected building taking into account all available information/evidence;
- m) Analysis of findings in the investigation work to determine the causes and sources of metal contamination as well as the extent of problematic pipework in the affected building taking into account all available information/evidence; and
- n) The qualified person shall prepare report on the investigation work conducted and the results including source and extent of the problem. The qualified person shall recommend rectification works (e.g. replacement of problematic pipework) in the report. Report template is given in **Appendix 11** for reference. The report is to be precise and comprehensive embracing all investigation work carried out by the qualified person.

Appendix 6 (Page 4 of 4)

Notes: An indicative time frame is provided below for QP/QC to systematically follow the general procedures of DI in order to analyze the findings in the site investigation works for making such conclusion for the following buildings:

<u>Number of floor</u>	<u>Building type</u>	<u>Working days required for site investigation</u>
35 – 40-storey	Residential building	18 – 24 depending on scale of examination for one building
5 – 6-storey	School	5 for single building
12-storey	Hospital	18 – 24 Depending on complexity of building and design of water supply system
35 – 40-storey	Office building	10 - 12
5 – 6-storey	Shopping mall (include catering)	18-24 Depending on scale and complexity of the building

The suggested duration is based on quick identification of source of contamination and use of non-destructive test. When the source of metal contamination cannot be clearly identified, two to three more days should be given for investigation. One investigation team is assumed in the estimation of the time frame.

For detailed investigation, the QC shall allocate more QPs and technicians to carry out extra works as and when required for works that have building and time constraints.

Remarks:

- 1) The time frame includes the preparation and coordination time required, examination of pipework in the concerned premises and collecting water sample and obtaining test results from laboratory.
- 2) The timeframe does not include the preparation of an investigation report. It is envisaged that 6 - 10 days will be needed.

Appendix 7

General Guideline for Investigating Other Floors of a Building

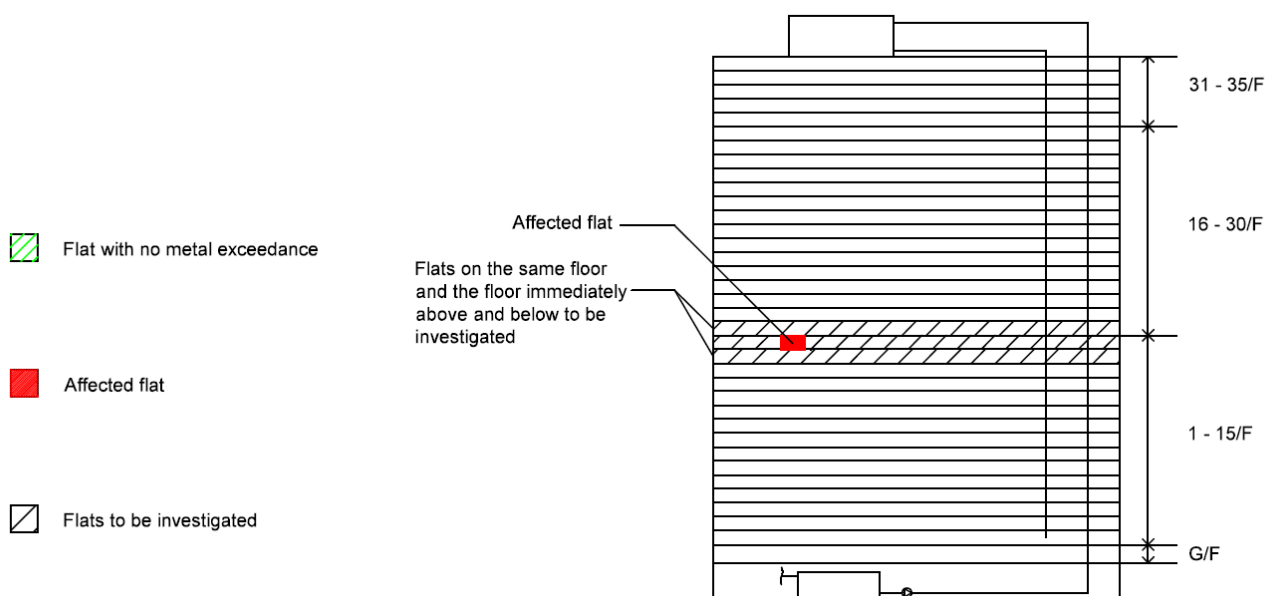


Figure 1

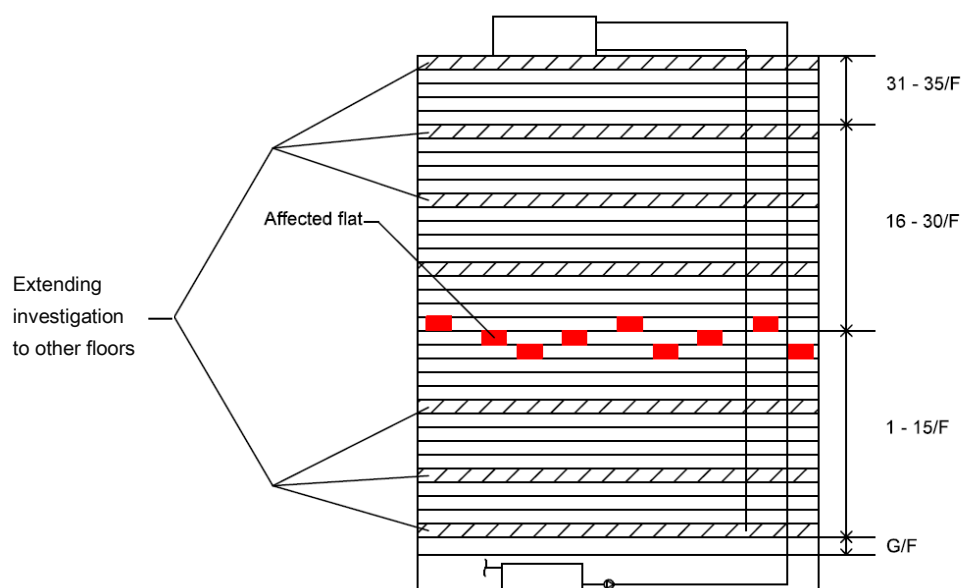
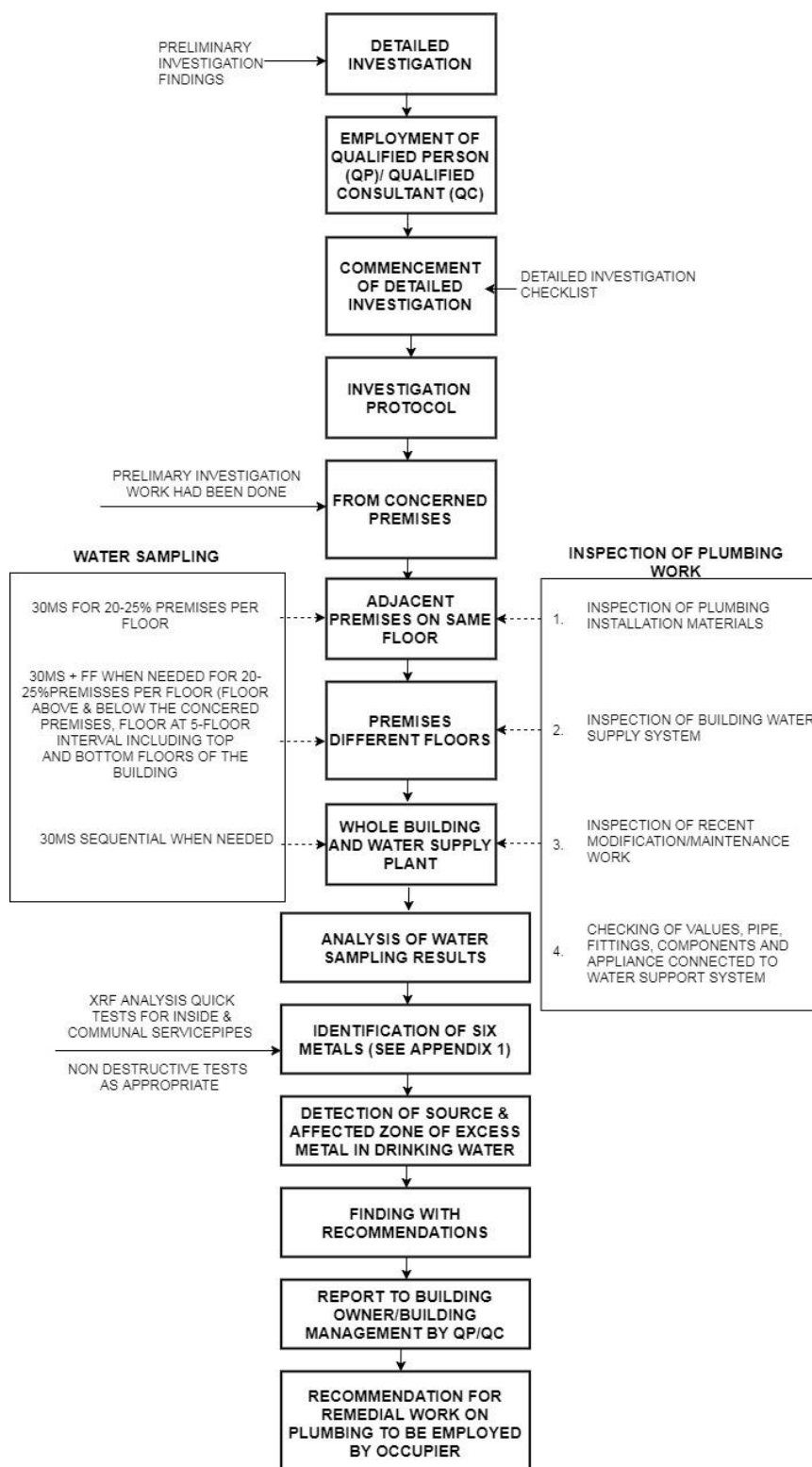


Figure 2

Appendix 8

Flowchart for DI



Appendix 9 (Page 1 of 2)**Investigation Checklist for DI**

Item	Procedure	Yes	No	Remark
1	Review of previous water sampling test results	<input type="checkbox"/>	<input type="checkbox"/>	
2	Desktop review of as-fitted plumbing drawings of water supply system and other relevant information. Provide site survey if drawings are not available	<input type="checkbox"/>	<input type="checkbox"/>	
3	Desktop review of material specifications of pipes, fittings, valves used for water supply system. QP/QC to provide survey when those are not available	<input type="checkbox"/>	<input type="checkbox"/>	
4	Enquiry on any modifications to plumbing installation including piping materials of water supply system and maintenance works/ prolonged stagnation	<input type="checkbox"/>	<input type="checkbox"/>	
5	Use table (Appendix A) 'Possible sources in approved plumbing component' to check source of contaminations (e.g. pipe, fitting, valve)	<input type="checkbox"/>	<input type="checkbox"/>	
6	Visual inspection of plumbing system and its installations e.g. system configuration, layouts and alignments, pipe connection methods, deadlegs, etc.	<input type="checkbox"/>	<input type="checkbox"/>	
7	Take 30 Minute stagnation (30MS) (including FF if needed) water samples from the drinking water taps in neighbouring premises (20-25%) on the same floor of the concerned premises with exceedance of certain metal parameter(s) and the floors immediately above and below, followed by NDT using instant test swab for lead and XRF Analyzer for all six metals (for exposed pipework) or sequential water samples (for concealed pipework) when necessary to check if the concerned metal contamination problem is also found	<input type="checkbox"/>	<input type="checkbox"/>	
8	Take water samples from fresh/potable water tanks	<input type="checkbox"/>	<input type="checkbox"/>	

Appendix 9 (Page 1 of 2)

Item	Procedure	Yes	No	Remark
9	Extend the investigation to different floors at 5-floor interval (i.e. a typical 15-floor zone height) including the most top and bottom floors of the building by taking 30MS water samples followed by NDT or sequential water samples when necessary unless the cause, source and extent of exceedance can be concluded or another protocol is found more suitable for extending the investigation to other floors	<input type="checkbox"/>	<input type="checkbox"/>	
10	Possibly carry out further investigation in other premises and on other floors based on the findings and pattern of exceedance.	<input type="checkbox"/>	<input type="checkbox"/>	
11	Determine the potentially affected zone due to the exceedance of the concerned metal contamination in building	<input type="checkbox"/>	<input type="checkbox"/>	
12	Analyse findings to determine the causes and sources of metal contamination as well as the extent of problematic pipework	<input type="checkbox"/>	<input type="checkbox"/>	
13	Prepare detailed investigation report to include findings and recommendations on necessary remedial works	<input type="checkbox"/>	<input type="checkbox"/>	

Appendix 10

Visual Inspection Checklist for DI

Works to be carried out

1. Explanation of purpose of site survey with assistance from building management for entry to pipe duct, ceiling void, water meter room, water supply plant and other premises as required for the investigation
2. Follow water supply drawing, check pipe run from the water meter from the concerned premises to the beginning of the inside service (i.e. pipework from the site boundary to the check meter position at G/F level)
3. When drawings and records of plumbing systems are not available, the qualified person/consultant must carry out a detailed site survey to fully ascertain the piping arrangement before carrying out the investigation
4. Investigate pipework in the remaining inside service (excluding the water meter serving the concerned premises) including all communal service pipework between ground floor transfer water tank, roof water tank and common water supply pipe serving all water meters in the building
5. Check and note any modification of the plumbing system
6. Check and note pipe and valve material of (4) above by using XRF analyzer to ascertain the metal composition in each part of the communal service
7. When it is necessary to examine floor above and below the concerned premises, the branches serving these two extra floors should also be similarly checked
8. In case extra floors of other water supply zones serving this building are to be examined, the qualified person/consultant should check all communal service and pipework from the respective water meters serving the selected premises.

Appendix 11 (Page 1 of 3)**Report Template**

Report on the investigation of metal leaching in drinking water			
Prepared by:	(Name of Investigator/Company Name)	Date	(Month, Year)
INTRODUCTION			
<p>Information to be included in this section:</p> <ul style="list-style-type: none"> • Date and location of the investigation • Reason for carrying the investigation (i.e. excess metal content(s) in drinking water was confirmed by previous water sampling results) <p>Purpose of the investigation (i.e. identify the source and scale of metal contamination in drinking water)</p>			
VENUE AND TIME			
Date	(DD/MM/YYYY)	Time	(HH:MM – HH:MM)
Location	(Address of the concerned premises)		
INVESTIGATION TEAM MEMBER			
Name	Company and Capacity	Signature	
(Name of Member 1)	(Company Full Name)		
(Name of Member 2)	(Company Full Name)		
(Name of Member 3)	(Company Full Name)		
(Name of Member 4)	(Company Full Name)		
DETAILS OF INVESTIGATION			
<p>A) Visual Inspection:</p> <p>Information to be included in this section:</p> <ul style="list-style-type: none"> • Location of water meter room • Discrepancy between the actual installation and the as-fitted plumbing drawings. Site survey results if drawings are unavailable • Pipe dimension (length, diameter) • Material of the pipework, pipe joining method, arrangement of valve • Brand/ BS standard mark on components of the water distribution system • Piping arrangement • Visible corrosion on pipe surface (i.e. location, size, colour etc.) • Water filter/ strainer attached to the tap/ under the kitchen sink 			

Appendix 11 (Page 2 of 3)**B) Tests Performed in the Inspection:**

- Non-destructive test (NDT) used
- Locations of pipes, fittings and joints detected using XRF analyser and recorded in a drawing / sketch with readings.

C) Water Sampling

- Water sampling methods
- Details of water sampling (i.e. measured flow rate of the tap, volume in the pipe between water meter and the kitchen draw-off/ in the communal service, number of successive stagnant samples taken etc.)

N.B. the above sections should be filled in on the day of the investigation

ANALYSIS OF WATER SAMPLING AND NDT RESULTS

Information to be included in this section:

- Water sampling results (i.e. number of samples exceeded the WHO standard, amount of metal contents in the water samples to be shown in a table)
- Indication of the water sampling results (i.e. location of the source of metal contamination, source of metal contamination is inside or outside of the premises)
- NDT results (i.e. composition of piping material, quantity of non-compliant components in the water distribution system)
- Appraisal of NDT results - to indicate metal leaching in pipework (give location of pipe joints and valves, etc.)
- Consistency between water sampling results and NDT results

N.B This section is to be written in detail.

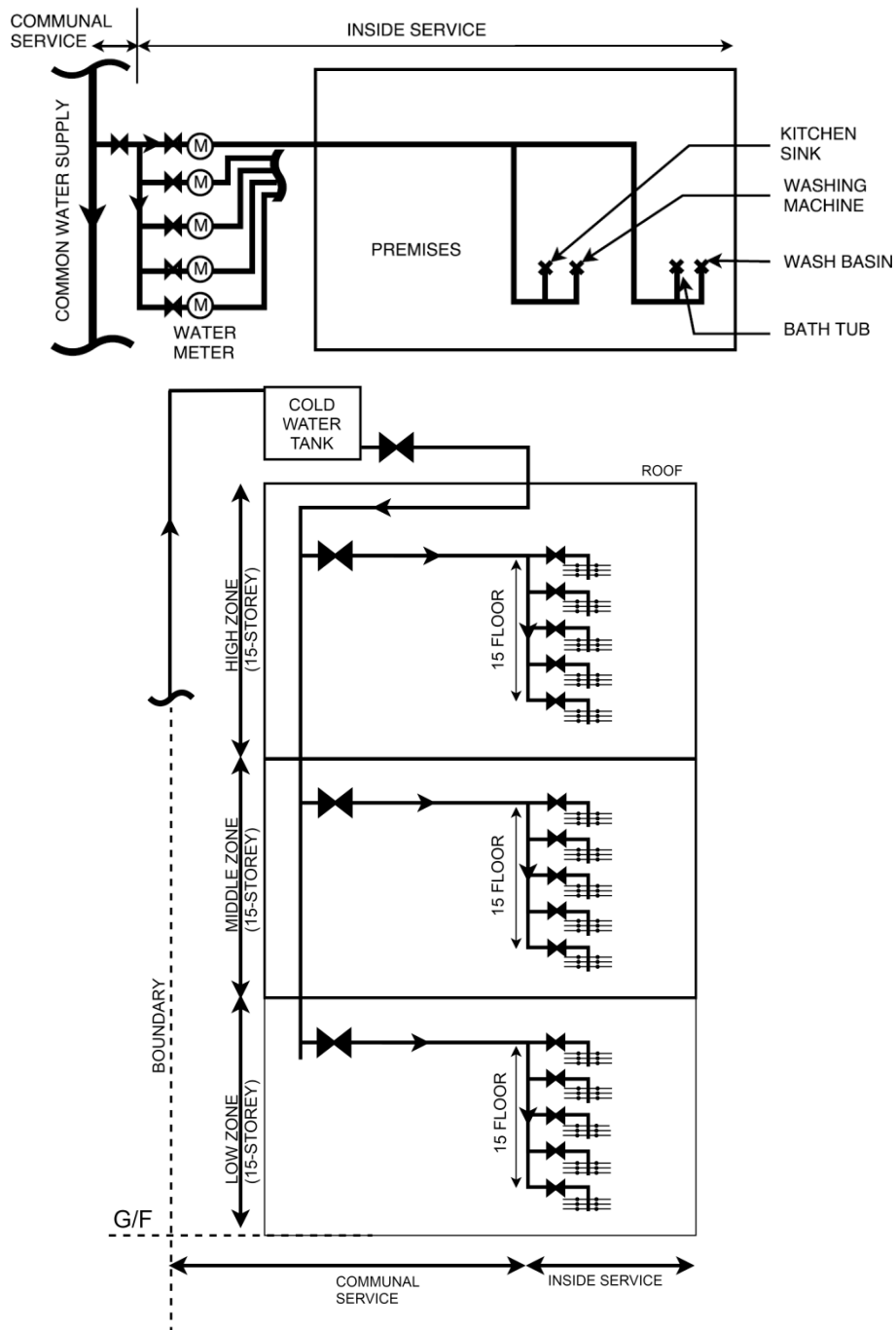
CONCLUSION

- State whether the source of metal contamination is identified
- State the extent of metal contamination
- Suggestion for temporary/ permanent remedial measure
- Further action

REMARK

Any other relevant information can be added in this section (i.e. water sampling results, XRF results, photos and sketches of piping arrangement and the area being investigated)

Appendix 11 (Page 3 of 3)



[sample sketches for investigation for premises and buildings respectively]

Prepared by (Name):

(Signature) _____

Date: _____

Endorsed by (Name):

(Signature) _____

Date: _____