

Central Library Building Earthquake Repairs

Building Services Design
Features Report

Wellington City Council

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1 Introduction

1.1 Project overview

The Wellington Central Library building has been closed due to low structural NBS rating of this building.

WCC has engaged Aurecon to develop high level structural and building services design schemes for the strengthening of the Central Library to achieve:

- Option 1 – Base case, nominally 40% NBS at IL3;
- Option 2 – Market acceptable, nominally 80% NBS at IL3 (if feasible); and
- Option 2A – Base isolation variant for Option 2, nominally 80% NBS at IL3 (if feasible).

Aurecon has been tasked to provide structural strengthening advice and building services recommendations for high level costing purposes only. This report is to provide Wellington City Council (WCC) with guidance for building services costing and considers the following:

- Condition Assessment commentary - existing plant that is at end of life and needs to be replaced;
- Impact of structural repair schemes on building services elements, including identification of plant that needs to be added or replaced due to strengthening;
- Commentary regarding re-use versus replacement strategy;
- The impact of separating the precinct services to allow the Library to be a standalone building; and
- Risks and assumptions associated with the above commentary.

1.2 Scope of Work

The scope of work for building services is to provide marked up drawings and a report to highlight at a high level the impacts of the structural works. The scope of services includes:

- Mechanical (HVAC)
- Hydraulics
- Fire Protection
- Electrical (including ICT)

1.3 Deliverables

The building services deliverables will generally be as follows:

- Design features report; and
- Marked up Building Services Layout drawings.

1.4 Key Assumptions

We have made the following assumptions in the preparation of this document:

- No change to the functional performance requirements within each space, eg types of services supplied to each floor will generally be the same as existing to deliver the same level of service.
- The existing installation generally meets current code requirements, unless otherwise specifically noted within the report / drawings.

1.5 Reference Documents

This report provides a high-level summary of the condition of the existing building services within the Central Library building. Aurecon has previously completed a detailed condition assessment review of this building as part of a wider campus review:

- Wellington Civic Campus Condition Assessment Report dated 28 September 2016 (Reference: 253267), including appendices

2 Mechanical Services

2.1 Condition Assessment Recommendations

As described in the *HVAC Services Review Condition Assessment Report* (appended), most of the mechanical services equipment is aged and near the end of its economic and expected design life.

It should be noted that Aurecon has not investigated alternative options for replacement system selection for this building yet, and the final design solution may be considerably different than the current design solution.

Based on the condition assessment observations, key recommendations for the replacement of mechanical equipment are as follows below.

- Replace all chilled water pipework in the building;
- Replace existing boilers with new higher efficiency boilers or heat pumps;
- Replace all heating water pipework and associated equipment;
- Replace all eight library air handling units;
- Replace all return air fans;
- Replace all fan coil units;
- Replace all VAV boxes;
- Replace the majority of on-floor ductwork and replace all ductwork components such as motorised dampers;
- Replace the toilet extract fans and potentially replace all toilet extract ductwork;
- Replace all (nine) basement carpark fans;
- Replace the BMS in its totality including all associated cabling and equipment.

A detailed description of the observations and recommendations from the condition assessment can be found in the following sections.

2.1.1 Chilled Water System

Chilled water for the Library is generated by the WCC precinct cooling plant. The central cooling plant is in the common basement near the Civic Administration Building (CAB) building. Due to the seismic risk, access to the central cooling plant is restricted. This plant has operational issues and is at the end of its economic life; as described in the condition assessment report.

Aurecon has also been requested by WCC to investigate de-centralisation of the precinct plant.

Aurecon therefore recommends to allowance be made for 2 x 1MW dedicated air-cooled chillers on the roof of the library, along with its ancillary equipment such as chilled water pumps, buffer tanks etc.

The roof of the library will require strengthening to accommodate the chilled water plant installation. The roof strengthening will need to accommodate required acoustic treatment, along with access and safety provisions such as platforms, handrails etc. A plant room (approximately 36 m²) will need to be built at roof level to accommodate the chilled water system ancillary plant including pumps, switchboards and the like.

It is anticipated that all chilled water pipework within the building will need to be replaced.

2.1.2 Heating Water System

The Library heating water system is served by gas boilers located within a roof level plant room. The boilers had their gas burners replaced in 2010 and appear (along with their associated primary pumps) to still be in an acceptable working condition and therefore, could be retained.

Table 1 Condition Assessment Boiler Summary

Equipment	Model	Nominal Heating Capacity (kW)	Age (Years)	Anticipated Service Life (Years)	Comment
Boiler 1	Aquatherm A770	750	26	20	Gas burners replaced in 2010
Boiler 1	Aquatherm A770	750	26	20	Gas burners replaced in 2010

However, to increase the building energy efficiency, it is recommended to consider:

- Replacing the boilers with high efficiency condensing boilers (cost benefit analysis required)
- Replacing the boilers with heat pump chillers (this would have much higher CAPEX, a shorter working life and may not be economic, once again cost benefit analysis required).

The two options listed above are considered additional options that would be subject to further analysis.

It is anticipated that all the heating water pipework and associated equipment will need to be replaced.

2.1.3 Air Handling Units (AHUs)

The condition assessment indicates the AHU components are aged at the end of their economic and design life. Aurecon recommends utilising the current opportunity to replace all 8 of the AHUs.

The replacement AHU's should be selected to be more energy efficient and consideration should be given to inclusion of heat recovery where possible which will provide energy savings and lower OPEX costs.

Table 2 Condition Assessment Air Handling Unit Summary

Equipment	Air Flow (L/s)	Design Cooling Conditions (DB°C/WB°C)	Age (Years)	Anticipated Service Life (Years)	Comment
AHU.LIB.1.1.1	8,900	Entering: 22.2 / 16.0 Leaving: 10.4 / 9.5	26	20	Corrosion is visible on the air handling unit casing
AHU.LIB.1.1.2	8,900	Entering: 22.2 / 16.0 Leaving: 10.4 / 9.5	26	20	Corrosion is visible on the air handling unit casing
AHU.LIB.1.2.1	8,900	Entering: 19.6 / 14.5 Leaving: 9.8 / 9.3	26	20	Corrosion is visible on the air handling unit casing
AHU.LIB.1.2.2	8,900	Entering: 21.1 / 15.3 Leaving: 10.1 / 9.8	26	20	Corrosion is visible on the air handling unit casing
AHU.LIB.2.1	9,100	Entering: 18.8 / 14.0 Leaving: 10.7 / 9.8	26	20	Corrosion is visible on the air handling unit casing
AHU.LIB.2.2	9,000	Entering: 18.7 / 14.0 Leaving: 10.0 / 9.6	26	20	Corrosion is visible on the air handling unit casing
AHU.REN.1.1	9,600	Entering: 17.4 / 13.0 Leaving: 12.0 / 11.0	26	20	Corrosion is visible on the air handling unit casing
AHU.REN.1.2	9,700	Entering: 17.4 / 13.0 Leaving: 12.3 / 11.5	26	20	Corrosion is visible on the air handling unit casing

Fan guards are to be installed for all AHU fans

2.1.4 Return Air Fans

The return air fans were designed to draw air from the various spaces back to the main plantroom at roof level.

The condition assessment indicated the return air fans are well maintained and are in a relatively good condition, however these units have reached the end of their intended design life. Aurecon recommends utilising the current opportunity to replace the fans.

Table 3 Condition Assessment Return Air Fan Summary

Equipment	Air Flow (L/s)	Age (Years)	Anticipated Service Life (Years)	Comment
EF.LIB.1	28,300	26	15	The fan will need replacement in the next 2-5 years
EF.LIB.2	28,300	26	15	The fan will need replacement in the next 2-5 years
EF.REN.1.1	7,700	26	15	The fan will need replacement in the next 2-5 years
EF.REN.1.2	7,800	26	15	The fan will need replacement in the next 2-5 years

2.1.5 On-floor Air Conditioning Systems

The on-floor air conditioning equipment for the Library consists of local 4-pipe fan coil units (FCU) serving ground floor, level 1 and level 2 and variable airflow volume (VAV) boxes serving the office floors (Levels 3 and 4).

Fan Coil Units

Additional FCUs have been added throughout the life of the building to suit building alterations, however the majority of the FCUs are aged and have had 28 years of service life, with an anticipated service life for these units of only 20 years.

Aurecon recommends using this opportunity to replace the FCUs with modern units incorporating EC motors. These new EC motored FCUs are likely to provide energy savings as they have better fan speed control.

Variable Air Volume Boxes

The various VAVs installed at Level 3 and 4 were not inspected during the condition assessment, however based on feedback from the maintenance contractor at the time the condition assessment was carried out previously, the units are functional but would require new actuators new BMS controllers and re-balancing. Aurecon recommends that full allowance for replacing the VAV boxes is made as the majority are likely to need to come down for the strengthening works. It is unlikely to make economic sense to store these units for extended periods and then test, and upgrade them at a later stage. Additionally, the structural strengthening scheme may not allow space for a VAV system to be reinstalled; a VAV system requires large duct sizes compared to other air conditioning systems. If these ducts are required to be routed below structural strengthening works, it may mean that the suspended ceiling will need to be reinstalled at a lower height than existing. This lowered ceiling height will need to be discussed with the client to determine whether it is acceptable.

Due to the strengthening works it is likely the floor ductwork will require replacement. All the motorised dampers and other components on this ductwork are likely to be end of life and unsuitable for reuse.

It may be possible to reuse the riser ductwork, but this will be subject to the strengthening and design requirements.

2.1.6 Toilet Exhaust Systems

The toilet exhaust system consists of two separate ducted extract systems located on either side of the building. These systems extract air from the various toilet blocks and discharge at roof level.

Each system is provided with a duty/standby extraction fan providing 100% redundancy. As these fans have exceeded their anticipated service life, Aurecon recommends replacing these fans.

It is possible that the main duct work could be retained and reused if the toilet block locations are not altered

Table 4 Condition Assessment Toilet Exhaust Fan Summary

Equipment	Air Flow (L/s)	Age (Years)	Anticipated Service Life (Years)	Comment
TE.LIB.1.1	1,020	26	15	Corrosion is visible on the units

Equipment	Air Flow (L/s)	Age (Years)	Anticipated Service Life (Years)	Comment
TE.LIB.1.2	1,020	26	15	Corrosion is visible on the units
TE.LIB.2.1	1,020	26	15	Corrosion is visible on the units
TE.LIB.2.2	1,020	26	15	Corrosion is visible on the units

Basement Supply and Exhaust Ventilation System

The library basement levels are provided with car park ventilation fans and also supply and extract fans for various areas. There are nine basement level fans in total, of which four fans are supply air fans and five others are exhaust air fans. As these basement level fans have exceeded their anticipated service life, Aurecon recommends replacement.

Additionally, the ductwork in this space is likely to be significantly affected by the strengthening works and should be assumed as needing replacement for budgeting purposes.

Table 5 Condition Assessment Basement Supply Fan Summary

Equipment	Air Flow (L/s)	Age (Years)	Anticipated Service Life (Years)	Comment
SF.LIB.B.WS.1	1,650	26	15	Fresh air for the library workshop areas
SF.LIB.B.PR.1	7,350	26	15	Fresh air for the plantroom toilets and gym and also carpark make-up air
SF.LIB.B.CP.1	5,850	26	15	Carpark make-up air
SF.LIB.B.CP.2	5,850	26	15	Carpark make-up air

Table 6 Condition Assessment Basement Exhaust Fan Summary

Equipment	Air Flow (L/s)	Age (Years)	Anticipated Service Life (Years)	Comment
EF.LIB.B.CP.1	9,670	26	15	Carpark exhaust air fan
EF.LIB.B.CP.2	7,370	26	15	Carpark exhaust air fan
EF.LIB.B.CP.3	2,870	26	15	Carpark exhaust air fan
EF.LIB.B.CP.4	7,700	26	15	Carpark exhaust air fan
EF.LIB.B.WS.1	430	26	15	Workshop / carpenters extract air fan

2.1.7 Building Management System (BMS)

The existing Library BMS system is dated and will need to be replaced in its totality, this includes the master controllers down to the Local Terminal Units (LTU) equipment including field cable wiring.

Aurecon recommends checking and replacing the control valves and control dampers on all the mechanical equipment.

2.2 Seismic Upgrade Implications

Refer to the appended drawings showing the high level implications for each seismic upgrade option against the Mechanical services. The following sections summarise the implications of the base case seismic upgrade, the market acceptable seismic upgrade, and the separation of services works:

2.2.1 Base Case Upgrade

The base case upgrade option assumes the requirement to maximise re-use where possible of existing services. The following is a summary of how these requirements can be implemented:

- The on-floor ducting shall be removed to allow for the structural strengthening, and then replaced with new ducting and insulation post structural strengthening.
 - On-floor ducting shall be reinstalled into approximately the same position as the previously installed ductwork; where this is not possible, the ducting shall be re-routed and coordinated with the structural strengthening works.
 - Disconnection and re-instatement shall be localised to areas that require strengthening only.
 - Any retained ductwork will need to be checked that their condition is acceptable prior to re-use.
 - It is expected to be uneconomical to remove and re-instate flexible ductwork. Therefore, new flexible ductwork should be allowed for.
- The on-floor pipework shall be removed to allow for the structural strengthening, and then replaced with new pipework and insulation post structural strengthening.
 - On-floor pipework shall be reinstalled into approximately the same position as the previously installed pipework; where this is not possible, the pipework shall be re-routed and coordinated with the structural strengthening works.
 - The disconnection and re-instatement shall be localised to areas that require strengthening only.
 - Any retained pipework will need to be checked that their condition is acceptable prior to re-use.
- Air terminals shall be removed to allow for structural strengthening, and then reinstated with the existing air terminals post structural strengthening.
 - Air terminals shall be reinstated into approximately the same position as the previously installed air terminals; where this is not possible, the air terminals shall be placed in a suitable location and be coordinated with the structural strengthening works.
 - Any air terminals that are damaged or are unable to be retained shall be replaced with new.
 - Air terminals which are able to be retained shall be cleaned prior to re-use.
- Where services' risers have been identified to be impacted on the mechanical design sketches, they will be required to be re-coordinated to a suitable location.
- For levels 3 and 4, the suspended ceiling will need to be removed to gain access to the mechanical services.
- Any modifications to ductwork, pipework, equipment, etc. will require their reinstatement to be seismically restrained in accordance with the latest version NZS 4219
- In the event that fire dampers and fire stopping are impacted by strengthening works, the fire stopping shall be reinstalled with new, and the fire dampers shall be reinstated where possible or replaced with the new equivalent Holyoake (or equal approved) model fire damper.
 - Where fire dampers are re-used, they will need to be checked prior to re-use to confirm that the installation of the damper meets the current fire requirements.
- Required works identified in the condition assessment report that either represent health and safety risks or items that do not work:
 - The supply air fans on the air handling units shall have fan guards installed.
 - Motorised fresh air dampers on some of the air handling units are not operational and are required to be replaced with new and systems recommissioned
 - The maintenance contractor had identified that the existing VAV boxes are functional but require new actuators and BMS controllers.
 - The current BMS is at end-of-life; works are required for the motorised dampers for the air handling units and the VAV box actuators and controllers require replacement. Therefore, it is highly recommended as part of this base case option to upgrade the BMS in its totality including the master controllers, local terminal units, and field cabling wiring. In addition, all control valves and control dampers on all the mechanical equipment should be checked on whether they need replacement.

Retroactively replacing the BMS and mechanical controls post strengthening works would require the taking the library out of operation whilst works commenced.

- Recommission and rebalance all mechanical systems.

Key Assumptions

- The base case option assumes the requirement to maximise the re-use of existing services and plant.
- The base case option does not take into account the decentralisation of services for the Central Library from the precinct infrastructure.
- This base case option does not take into account the recommended upgrades to existing services and plant as identified in the condition assessment report done by Aurecon circa 2016.
- The base case option assumes that all items identified in the condition assessment report as not working or presenting a health and safety risk will be replaced with new.
- It is assumed there are no changes to the usage and general arrangement of the library floors. Where areas are required to be entirely stripped out to allow for strengthening works (e.g. bathroom areas), it is assumed that these areas will be reinstated to match the existing layout.
- It is assumed there are no changes to the fire engineering requirements.
- Where any items are to be retained and reused, it is expected they are inspected prior to their reinstatement for their suitability for reuse. Where they are not deemed to be suitable for reuse, they shall be replaced with new.
- No consideration has been given to whether there should be a HVAC system design change or modification to the existing controls strategy.

Risks

- The base case option does not take into account the decentralisation of services for the Central Library from the precinct infrastructure. Plant replacement and or upgrades required for the decentralisation of services would be above and beyond what is documented for this option.

Any required work will impact existing and reinstated services from the base case option if implemented at a later date.

- The base case option does not take into account all of the recommended upgrades to existing services and plant as identified in the condition assessment report done by Aurecon circa 2016. As a result, the re-used plant are at a higher risk of failing and may incur increasing maintenance costs.

Re-used plant has a higher risk of failure than new plant and may incur increasing maintenance costs.

- Future replacement of any large plant (chillers, boilers, fans, and etc.) will impact the operation of the library, may incur downtime to get systems operational again, and may require additional structural strengthening works.
- Re-use of existing plant, particularly on-floor systems (VAV boxes, fan coil units, control dampers, and etc.) run the risk of failure during reinstatement which will impact the operation and potential opening of the library building.
- Deterioration of plant that has been left idle and/or not regularly maintained since the closure of the library resulting in more equipment requiring replacement and/or increased costs to repair the equipment to an acceptable working condition.
- Where equipment has been identified as suitable for reuse, measures need to be taken to remove it in a careful and systematic manner to prevent damage, clean the item, and to store the equipment properly to prevent any further degradation prior to them being reinstated.

In general, replacing the existing equipment is considered preferable as reuse of the existing equipment and air terminals requires careful removal, cleaning and storage to prevent damage.

- There is a risk the reinstated ducting and piping routes do not match existing routes and require modification to suit incurring additional coordination work.
- Where services' risers are required to be relocated, structural investigations may be required to determine a new suitable location. Additionally, coordination with all other building services will be needed, and a check that any new service routes do not adversely affect the performance of the mechanical plant.
- For levels 3 and 4; post structural strengthening works; it is likely that in some instances the ducting will need to be re-coordinated to run beneath structural elements. As a result the suspended ceiling may not be able to be reinstated at the same ceiling height.
 - The worse-case scenario is ducting along the perimeter of the floor requiring to be dropped by approximately 410mm.
 - A majority of the on-floor ducting will require to be dropped by approximately 200mm
- For levels 3 and 4, the requirement for the seismic bracing of services may further impact the level at which the suspended ceiling may be able to be reinstated at.
- As identified in the above points, in general, remedial works after the strengthening works have been completed will affect the operation of the library.

2.2.2 Market Acceptable Upgrade

The market acceptable option assumes the requirement to generally replace existing services and also includes the work required for the decentralisation of services. The following is a summary of how these requirements can be implemented:

- All on-floor ducting (including all flexible ductwork) shall be removed to allow for the structural strengthening, and then replaced with new ducting and insulation post structural strengthening. In general, the ducting shall be reinstated using the same routes as existing.
 - It may be possible to reuse the riser ductwork, but this will be subject to the strengthening and design requirements
- All on-floor pipework shall be removed to allow for the structural strengthening, and then replaced with new pipework and insulation post structural strengthening. In general, the pipework shall be reinstated using the same routes as existing.
- All air terminals shall be removed to allow for structural strengthening, and then reinstated with:
 - Existing air terminals which have been inspected and cleaned, and are in good condition for re-use
 - New air terminals to match existing where the existing air terminals are not in good condition to be re-used.

Air terminals shall be reinstated into approximately the same position as the previously installed air terminals; where this is not possible, the air terminals shall be placed in a suitable location and coordinated with the structural strengthening works.

- Where services' risers have been identified to be impacted on the mechanical design sketches, they will be required to be re-coordinated to a suitable location.
- For levels 3 and 4, the suspended ceiling will need to be removed to gain access to the mechanical services.
- Any modifications to ductwork, pipework, equipment, and etc. will require their reinstatement to be seismically restrained in accordance with the latest version NZS 4219
- In the event that fire dampers and fire stopping are impacted by strengthening works, the fire stopping shall be reinstated, and the fire dampers shall be reinstated where possible or replaced with the new equivalent Holyoake (or equal approved) model fire damper.
 - Where fire dampers are re-used, they will need to be checked prior to re-use and confirm that the installation of the damper meets the current fire requirements.

- Two (2) new 1 MW dedicated air-cooled chillers on the roof of the library building for the decentralisation of the chilled water services. This will include all ancillary equipment such as chilled water pumps, buffer tanks etc. Furthermore, if a heat-pump chiller is used to replace the existing boilers, this would be able to provide additional cooling capacity and redundancy in the cooling system.
 - The roof of the library building will require strengthening to accommodate the chilled water plant installation. The roof strengthening will need to accommodate required acoustic treatment, along with access and safety provisions such as platforms, handrails etc. A plant room (approximately 36m²) will need to be built at roof level to accommodate the chilled water system ancillary plant including pumps, switchboards and the like.
- Replace existing gas boilers with either (dependent on a cost benefit analysis):
 - High efficiency condensing boilers; OR
 - Heat-pump chillers
- Replace all existing air handling units with new, more energy efficient models which have heat recovery features where possible.
- Replace all fans with new, including:
 - all return fans
 - all toilet extract fans
 - all basement supply and extract fans
- Replace all fan coil units with modern units incorporating EC motors.
- Replace all VAV boxes with new.
- Replace all auxiliary equipment such as control dampers, control valves, and etc.
- Replace the existing library BMS in its totality including master controllers, local terminal units, field control wiring, and etc.
- Recommission and rebalance all mechanical systems prior to library operation.

Key Assumptions

- The market acceptable option assumes the requirement to generally replace existing services.
- The market acceptable option takes into account the decentralisation of services.
- The market acceptable option takes into account the recommended upgrades to existing services and plant as identified in the condition assessment report done by Aurecon circa 2016.
- Further investigation is required (cost benefit analysis, heat load calculations, energy calculations, and etc.) for the specific replacements of major plant.
- It is assumed there are no changes to the usage and general arrangement of the library floors. Where areas are required to be entirely stripped out to allow for strengthening works (e.g. bathroom areas), it is assumed that these areas will be reinstated to match the existing layout.
- It is assumed there are no changes to the fire engineering requirements.
- Where any items are to be retained and reused, it is expected they are inspected prior to their reinstatement for their suitability for reuse. Where they are not deemed to be suitable for reuse, they shall be replaced with new.
- No consideration has been given to whether there should be a HVAC system design change or modification to the existing controls strategy.

Risks

- Where equipment has been identified as suitable for reuse, measures need to be taken to remove the equipment in a careful and systematic manner to prevent damage, clean the item, and to store the equipment properly to prevent any further degradation prior to them being reinstated.
- Where services' risers are required to be relocated, structural investigations may be required to either create or determine a new suitable location. Additionally, coordination with all other building services will be needed, and a check that any new service routes do not adversely affect the performance of the mechanical plant.
- For levels 3 and 4, post structural strengthening works, it is likely that in some instances the ducting will need to be re-coordinated to run beneath structural elements. As a result the suspended ceiling may not be able to be reinstated at the same ceiling height.
 - The worse-case scenario is ducting along the perimeter of the floor requiring to be dropped by approximately 410mm.
 - A majority of the on-floor ducting will require to be dropped by approximately 200mm
- For levels 3 and 4, the requirement for the seismic bracing of services may further impact the level at which the suspended ceiling may be able to be reinstated at.

2.3 Separation of Services Implications

The following is a summary of the separation of services implications (note that this has been documented as part of the market acceptable option in the previous section):

- Two (2) new 1 MW dedicated air-cooled chillers on the roof of the library building for the decentralisation of the chilled water services. This will include all ancillary equipment such as chilled water pumps, buffer tanks etc. Furthermore, if a heat-pump chiller is used to replace the existing boilers, this would be able to provide additional cooling capacity and redundancy in the cooling system.
 - The roof of the library building will require strengthening to accommodate the chilled water plant installation. The roof strengthening will need to accommodate required acoustic treatment, along with access and safety provisions such as platforms, handrails etc. A plant room (approximately 36m²) will need to be built at roof level to accommodate the chilled water system ancillary plant including pumps, switchboards and the like.
 - All chilled water pipework will need to be replaced with new.

Key Assumptions:

- It is assumed there are no changes to the usage and general arrangement of the library floors. As a result, it is assumed the cooling load will be similar to the existing cooling load. Further investigation may be required to determine the 'best' option for the replacement chillers (e.g. exploring the feasibility of using water-cooled chillers and cooling towers, whether energy efficiency can be improved by using more smaller capacity chillers, and etc.).

Risks

- Increased maintenance costs associated with additional chillers.
- Level of redundancy will need to be finalised / agreed upon – this may result in additional chillers and therefore increased cost.
- Not using the centralised plant reduces the level of redundancy and diversity.

3 Fire Protection Services

3.1 Condition Assessment Recommendations

As described in the *Fire Protection Services Review Condition Assessment Report* (appended), Aurecon's observations and recommendations on the fire protection system are as follows below.

3.1.1 Fire Sprinkler System

The condition assessment report indicates the fire sprinkler system for the Library building was installed pre-1996 and most of the sprinkler system does not meet the current NZS 4541 requirements. The fire sprinkler system is likely to require replacement to allow the strengthening works to occur.

Further details are as follows:

- The extra light hazard sprinklers used within the office areas of the building generally appeared to be 10mm (3/8 BSPT) which NZS 4541 no longer allows. Although the 10mm sprinklers can stay if the ceilings are not being modified the strengthening requirements are likely to lead to replacement of the ceilings.
- Sprinklers installed into any new ceiling will need to meet the current seismic requirements and will need to incorporate flexible droppers.
- A detailed check and upgrade on the seismic restraint of any sprinkler equipment or pipework retained would be required.
- The existing sprinkler system has floor isolation valves and flow switches. These isolation valves and flow switch can be remained as long the location for the risers remains.
- A fire protection inspection service (FPIS) survey dated 04/03/2015 noted that external sprinklers were showing signs of corrosion. As part of any upgrade of the library; it is recommended to upgrade any external sprinklers (which have not already been upgraded) with corrosion resistant sprinklers suitable for the environment.
- At the time of condition assessment, the gong for control valve set #1 was damaged and requires repairs to maintain the system compliance.

3.1.2 Fire Alarm System

The fire alarm system for the Library building consists of analogue addressable smoke detectors (in limited locations around the atrium), manual call points, strobe lights, siren and main alarm panel.

As part of the works required for the seismic strengthening, it is recommended that an allowance is made to fully replace this system.

3.1.3 Hydrant System

As per the condition assessment report, the fire hydrant for the Library building is suspected to be dry riser. The current code requires all the hydrants to be charged.

Aurecon recommends a detailed check and upgrade be carried out.

Charging this system will require a 25mm water supply connection; complete with backflow prevention unit; to the current dry riser inlets located within the sprinkler valve room. A feed could be taken from the sprinkler incoming main located within the same space for this purpose.

It is likely remedial work will be required to the existing pipework as dry risers normally leak at the joints when charged for the first time.

The hydrants are located within both the stairs and are likely to require test facilities in the form of 100mm return pipes reticulated back to the sprinkler valve room, terminating at a test outlet.

3.2 Seismic Upgrade Implications

Refer to the appended drawings showing the high level implications for each seismic upgrade option against the Fire Protection services. The following sections summarise the implications of the base case seismic upgrade, the market acceptable upgrade, and the separation of services works.

3.2.1 Base Case Upgrade

The base case upgrade option assumes the requirement to maximise re-use where possible of existing services. The following is a summary of how these requirements can be implemented:

- Sprinkler pipework is to be disconnected where required to allow for structural strengthening works and then reinstated with new pipework.
- Where sprinklers are not touched or their locations are not modified, the existing sprinklers can be retained.
- The existing 10mm sprinklers can stay if the ceilings are not being modified. If the ceilings are to be modified, the sprinklers are recommended to be replaced with 15mm (1/2 BSPT) sprinklers meeting the current standard. Where 10mm sprinklers are replaced with 15mm, this should apply to all the sprinklers within a given area.
- It is recommended to upgrade any external sprinklers (which have not already been upgraded) with corrosion resistant sprinklers suitable for the environment.
- Sprinklers installed into new ceilings will need to meet the current seismic requirements and will need to incorporate either flexible droppers or 50mm clearance around the sprinkler with a suitably sized escutcheon plate to conceal the penetration. It is expected the flexible dropper option is used wherever sufficient clearance is available for these units to be installed.
- The fire stopping of the fire protection pipework will need to be checked and upgraded where necessary to meet current code levels.
- It is likely that the library building will require full smoke detection added throughout as part of the building upgrade. This would include standard point type detectors but may also include aspirated smoke detection or beam type smoke detection at the top of multi-level spaces.
 - The existing fire alarm panel has a number of spare zones, but further investigation would need to be carried out to determine if these would be sufficient for fully smoke detecting the building.
 - The existing fire alarm panel will need to be modified to incorporate the new smoke detectors and manual call points.
- Charge the existing fire hydrant riser by installing a connection off of the incoming water supply, complete with a backflow prevention unit, to the current dry riser located within the same space. The hydrants are located within both stairs and both hydrants are likely to require test facilities in the form of 100mm return pipes reticulated back to the sprinkler valve room, terminated at a test outlet.
- Repair the gong for control valve set #1, if it has not already been repaired.
- It is unlikely that the handheld fire protection will be required as part of any of the works.

The choice to retain or remove the handheld fire protection will be the WCC's, however, it is recommended as a minimum that fire extinguishers are retained for plant rooms, electrical cupboards, and similar spaces.

All fire extinguishers retained will require full 5-year maintenance check to ensure they are still compliant prior to reuse.

Any hose reels and fire extinguishers that are reused shall receive new NZS 4503 compliant signage.

- Whilst a large amount of the fire protection pipework and other equipment will be retained in its current form, it is expected that the seismic restraint of this pipework and equipment will need to be upgraded to meet the requirements of NZS 4541, NZS 4503, and NZS 4219 as applicable.

Key Assumptions

- The base case option assumes the requirement to maximise re-use where possible of existing services.
- The base case option takes into account the mandatory works as identified in Aurecon's condition assessment report to bring the building up to the latest building code.
- The building usage and function remains the same i.e. the hazard level of the existing sprinklers is sufficient for the expected use of the library
- No changes to the fire engineering requirements

Risks

- The fire sprinkler standard NZS 4541 is currently being amended and the draft amendments indicate that this standard is likely to be more onerous than the current standard. Subject to the date of the consent, the new standard may have to be complied with which may have additional scope not listed in the previous section above.
- Ensure that any sprinklers removed are disposed of and not reused, in accordance with the upcoming requirements of NZS 4541. Any damage to the bulb or sprinkler frame could cause a false activation of a sprinkler potentially creating the risk of significant flooding.
- Ensuring all fire stopping at penetrations at fire separations are checked and remediated / brought up to current code levels as required. There is the risk that the previously installed fire stopping has been compromised after the seismic events and may be compromised due the strengthening works.
- The structural strengthening works impacting the location of the fire hydrant causing the hydrant location and all associated pipework to be removed and re-coordinated. .

3.2.2 Market Acceptable Upgrade

The market acceptable option assumes the requirement to generally replace existing services. The following points below are a summary of how these requirements can be implemented. In general, the extent of works required for the market acceptable option are similar to those outlined in the base case option, and similarly with the assumptions and risks. In addition to the requirements of the base case upgrade, the following works are required:

- The backflow prevention for the fire sprinkler system was acceptable under the standard the system was installed under but does not meet the current building code or NZS 4541:2013 standards. Whilst there is no requirement to upgrade the backflow prevention on the system, it is recommended that the backflow prevention be upgraded to current building code levels.
- Upgrade the entire fire alarm system including full smoke detection. This would include standard point type detectors but may also include aspirated smoke detection or beam type smoke detection at the top of multi-level spaces.
- The existing fire panel can be modified to incorporate replacement smoke detectors and manual call points, however, an option that the library may consider exploring is to relocate the existing library panel for use at the Municipal Office Building (MOB) and install a new analogue addressable panel for the library.

Assumptions

- The market acceptable option takes into account the recommended works as identified in Aurecon's condition assessment report.
- The building usage and function remains the same i.e. the hazard level of the existing sprinklers is sufficient for the expected use of the library
- It is assumed all hose reels and fire extinguishers that are reused will receive new NZS 4503 compliant signage.

- No changes to the fire engineering requirements

Risks

- The upgrade to the backflow prevention system will be challenging due to the limited space available within the valve room, with significant re-piping of the sprinkler control valves and associated pipework required to create the space for a backflow prevention unit.
- The fire sprinkler standard NZS 4541 is currently being amended and the draft amendments indicate that this standard is likely to be more onerous than the current standard. Subject to the date of the consent, the new standard may have to be complied with which may have additional scope not listed in the previous section above.
- Ensure that any sprinklers removed are disposed of and not reused, in accordance with the upcoming requirements of NZS 4541. Any damage to the bulb or sprinkler frame could cause a false activation of a sprinkler potentially creating the risk of significant flooding.
- Ensuring all fire stopping at penetrations at fire separations are checked and remediated / brought up to current code levels as required. There is the risk that the previously installed fire stopping has been compromised after the seismic events and may be compromised due the strengthening works.
- The structural strengthening works impacting the location of the fire hydrant causing the hydrant location and all associated pipework to be removed and re-coordinated. It was identified that part of the market acceptable structural strengthening scheme encroached into the stairwell where the fire hydrants are located.

3.3 Separation of Services Implications

No significant impacts on the fire protection services were identified as part of the separation of services works.

4 Hydraulics Services

4.1 Condition Assessment Recommendations

As described in the *Hydraulic Services Review Condition Assessment Report* (appended) most of the hydraulics services equipment is original and was installed around 1991. In summary, the passive systems such as pipework and storage tanks are in reasonable condition and do not require replacement. Active components such as water heaters and fixtures should be replaced

Below are Aurecon's observations and recommendations regarding the hydraulics services components.

4.1.1 Water Supply Pipework

The water supply system consists of a single 50mm diameter connection from the public water main in Victoria Street. Mains pressure water is piped to storage tanks in the upper Roof Plantroom. Low pressure water is then reticulated from the tanks to the plumbing fixtures. The kitchenette sinks and drinking fountains adjacent to the cores are supplied directly with mains pressure cold water.

The water supply pipework is generally copper and has served approximately half of its indicative service life so does not require replacement.

There have been issues identified with some seized isolating valves and leaking mechanical joints. All valves and mechanical joints should be inspected with seized valves replaced and any leaks repaired.

4.1.2 Water Storage Tanks

The potable water storage system consists of six 3000 litre polyethylene tanks. Typical life would be 20-30 years however these tanks are in a non-aggressive environment and appear in reasonable condition. On that basis they do not require replacement. The connections, isolating valves and fill valves should be inspected and serviced or replaced as necessary.

Seismic restraints for the tanks are required.

4.1.3 Water Heaters

Most of the domestic hot water is supplied from two separate plantrooms on the Ground Floor. Each of these plantrooms contain two 250 litre electric hot water cylinders. Given their age these cylinders should be replaced. Consideration could be given to replacing these with heat pump hot water cylinders to improve energy efficiency. The water is currently circulated at 45°C which does not comply with the NZBC requirements for circulating systems to be maintained at not less than 60°C to prevent the spread of Legionella. The circulating temperature should be increased to at least 60°C or UV sterilisation systems installed. If the circulating temperature is raised, new tempering valves will be required for each group of fittings to ensure the hot water delivery temperature at the taps is within acceptable limits.

4.1.4 Sanitary Pipework

The sanitary plumbing pipework within the Library primarily consists of Solvent Cement Jointed uPVC. Much of the uPVC sanitary plumbing pipework appears to be in reasonable condition and is likely to remain serviceable well beyond the CIBSE indicative life expectancy of 20 years.

4.1.5 Sanitary Fixtures

The sanitary fixtures and fittings are of average condition and consistent with the age of the building. Some have been replaced due to failures.

We recommend that all the existing fixtures and fittings should be replaced with modern more water efficient fixtures and fittings.

4.1.6 Stormwater

The stormwater system drains from the gutters through 200 mm diameter solvent cement jointed PVC downpipes. These appear in reasonable condition and are likely to remain serviceable well beyond the CIBSE indicative life expectancy of 20 years. On this basis the downpipes do not require replacement.

4.2 Seismic Upgrade Implications

Refer to the appended drawings showing the high level implications for each seismic upgrade option against the Hydraulic services. The following sections summarise the implications of the base case seismic upgrade, the market acceptable upgrade, and the separation of services works:

4.2.1 Base Case Upgrade

The base case option assumes the requirement to maximise re-use where possible of existing services. The following is a summary of how these requirements can be implemented:

- The pipework in the basement carpark is to be disconnected and removed to allow for the structural strengthening works. Reinstating the pipework with new is highly preferable as, in order to retain and reuse the existing pipework, careful removal, cleaning and storage would be required to prevent damage.

When the average rate of a tradesperson is considered and the time required to complete this, including the time to re-coordinate routes, it is likely to be more cost effective to replace the existing with new rather than re-use existing.
- The strengthening works impact all the bathrooms in the building. To allow for the strengthening works to occur, it is expected all of the bathrooms would be stripped out and replaced with new equipment, including:
 - new sanitary pipework;
 - new water pipework;
 - new sanitary fixtures and fittings;
 - all associated equipment including valves.
- All valves and mechanical joints to be inspected with all seized valves replaced and any leaks repaired.
- Isolating valves and fill valves for the water storage tank should be inspected and serviced or replaced as necessary.
- Seismic restraint for the water storage tanks to be provided.
- All new and modified hydraulic services are to be seismically restrained in accordance with NZS 4219.
- Entire water system to be flushed; especially if domestic water pipework is being re-used; as it has been stagnant since the closure of the library.
- All sensors / detectors and other equipment monitored by the BMS are compatible with upgrades to the BMS.

Key Assumptions:

- It is assumed that the selection, supply, and installation of all sanitary fixtures and fittings is to be per the Architect's schedules.
- All / any external drainage changes will be documented by others

Risks

- The existing water heaters circulate water at 45°C which does not comply with the New Zealand building code requirements for the prevention of the spread of Legionella. The circulating temperature should be increased to at least 60°C or UV sterilisation systems installed. If the circulating temperature is raised, new tempering valves will be required for each group of fittings. Maintaining the current circulating hot water temperature of 45°C runs the risk of Legionella bacteria growth and spread.
- There is the potential that the rising mains, drainage stacks, vent risers and the like will be able to be retained and that new pipework at each floor level will utilise the existing connection points at each level. However, this will be dependent of the structural strengthening methodology and how it is implemented. Allowance should be made for the replacement of all pipework.
- Due to the structural strengthening works, the bathrooms may not be able to be reinstated in the same position as the existing bathrooms and may require to be relocated elsewhere. This will impact the location of existing hydraulic risers that could be re-used and the general hydraulic pipework routes.
- Deterioration of the plant if it has not been regularly maintained and/or used since the closure of the library resulting in replacement of plant that could have been reused or increased costs to bring the existing plant up to an acceptable working condition.

4.2.2 Market Acceptable Upgrade

The market acceptable option assumes the requirement to generally replace existing services. The below points are a summary of how these requirements can be implemented. In general, the extent of works required for the market acceptable option are similar to those outlined in the base case option, and similarly with the assumptions and risks. In addition to the requirements of the base case upgrade, the following works are required:

- Replace the existing water heaters with new heat pump hot water cylinders to improve energy efficiency and to circulate the hot water at over 60°C to prevent the spread of Legionella.
- If the mechanical boilers are replaced with a non-gas alternative, the gas supply pipework should be removed and isolated at the street connection point.

Key Assumptions:

- It is assumed that the selection, supply, and installation of all sanitary fixtures and fittings is to be per the Architect's schedules.
- All / any external drainage changes will be documented by others

Risks

- There is the potential that the rising mains, drainage stacks, vent risers and the like will be able to be retained and that new pipework at each floor level will utilise the existing connection points at each level. However, this will be dependent of the structural strengthening methodology and how it is implemented. Allowance should be made for the replacement of all pipework.
- Due to the structural strengthening works, the bathrooms may not be able to be reinstated in the same position as the existing bathrooms and may require to be relocated elsewhere. This will impact the location of existing hydraulic risers that could be re-used and the general hydraulic pipework routes.
- Deterioration of the plant if it has not been regularly maintained and/or used since the closure of the library resulting in replacement of plant that could have been reused or increased costs to bring the existing plant up to an acceptable working condition.

4.3 Separation of Services Implications

No significant impacts on the hydraulic services were identified as part of the separation of services works.

5 Electrical Services

5.1 Condition Assessment Recommendations

5.1.1 Power Supply

The Library building is part of the WCC Campus comprising of six buildings; Civic Administration Building (CAB), Municipal Office Building (MOB), Town Hall, Art Gallery and Michael Fowler Centre (MFC). The Library is supplied from a shared 750kVA Wellington Electricity transformer located in Substation #1 on the common basement level. This transformer supplies the Art Gallery and CAB in addition to the Library.

The adequacy of the existing transformer capacity with regards to the proposed work and existing buildings are not addressed in this report.

Aurecon recommend a dedicated transformer to be provided to the Library as part of the services separation from the Campus precinct. Ideally this transformer should be located above ground as there are concerns around the flood risk of the basement.

5.1.2 Standby Diesel Generator

The Library building is supplied with standby (essential) power from an existing 500kW (1000kVA unmatched alternator arrangement) standby diesel generator located in the common basement level. This generator also supplies essential power to CAB, MOB and Town Hall buildings.

The existing generator is approximately 26 years old. The life expectancy of a standby generator is in the order of 30 years.

The adequacy of the existing generator capacity with regards to the proposed work is not addressed in this report.

Aurecon recommend a dedicated standby diesel generator to be provided to the Library as part of the services separation from the Campus precinct. We would recommend this generator is located above ground as there are concerns around the flood risk of the basement.

5.1.3 Main Switchboard

The Library is supplied from WCC Camps main switchboard MSB.CP located in the common basement level. This main switchboard provides non-essential power to the Library, CAB, Art Gallery and limited essential power supply to Library, CAB, Art Gallery, MOB and Town Hall. The Library does not have a dedicated main switchboard.

The non-essential 1600 Amp circuit breakers on MSB.CP has been recently upgraded. These circuit breakers are in excellent condition and expected to operate reliably for the foreseeable future.

Aurecon recommend a dedicated main switchboard to be provided (above ground) to the Library as part of the services separation from the Campus precinct.

5.1.4 Automatic Transfer Switch

The existing circuit breaker automatic transfer switch (ATS) is from original construction in the 1990s. The life expectancy of low voltage (LV) switchgear is approximately 25 years and this switch may fail in near future. Aurecon recommend testing and maintenance of the ATS.

5.1.5 Distribution Boards

Each Library floor is served by essential and non-essential distribution boards located within the North and South electrical riser cupboards. The North riser cupboard contains the essential and non-essential distribution boards while the South riser only contains the non-essential distribution boards.

The floor distribution boards comprise of main switch, tap-off box, modern miniature circuit breakers (MCB) for final power sub-circuit protection and lighting control sections.

The circuit breakers do not appear to be provided with residual current protection devices (RCD).

The floor distribution boards are from the original construction in the 1990s and approximately 26 years old. The life expectancy of low voltage (LV) switchgear is approximately 25 years. Aurecon recommend replacing the existing switchboards complete with new switchgear and RCDs where required as part of the structural strengthening works.

5.1.6 General Lighting and Emergency Lighting

The lighting to the Library floor is provided via suspended fluorescent luminaire with direct and indirect light distribution.

The lighting to Level 3 and 4 office floors is generally provided via recessed 600x600mm fluorescent luminaires with prismatic diffusers.

The light fittings generally appear to be from original construction. The life expectancy of internal lighting systems is approximately 20 years. Aurecon suggest replacing the existing fluorescent lighting with energy efficient LED lighting system as part of the structural strengthening.

The Library and office floors are not provided with self-contained emergency luminaires. The emergency lighting is presently provided by normal lighting connected to the essential supply (generator backup). This type of emergency lighting does not comply with the latest Building Code. Aurecon recommend providing self-contained emergency lighting to comply with Building Code and fire engineering report as part of the structural strengthening works.

5.1.7 Small Power

Power distribution to the Library and office floors are via existing wall-mounted switched power outlets on wall or columns. Skirting trunking along the perimeter wall are installed in some areas. The life expectancy of switched socket outlets are approximately 15 years. Aurecon recommend replacing switched socket outlets as part of the structural strengthening works.

5.2 Seismic Upgrade Implications

Refer to the attached drawings showing the high-level implications for each seismic upgrade option against this service category. Generally, the requirements for both base case and market acceptable are the same. Please note the following differences between the schemes and services requirements:

- Diaphragm Strengthening – 40% scheme located only on top of Ground floor slab. 80% scheme- located on all levels. Penetrations in FRP required for floor boxes to be re-instated- floor requires scanning to ensure that the prestressing strands in the floor are not cut. Structural framing may be required to support floor units if floor boxes are not parallel to direction of hollowcore.
- Seismic Frame- 40% scheme has no seismic frames, seismic frames located on all levels for 80% scheme. All hardware including security cameras and cabling to be re-located to accommodate proposed strengthening works where necessary.
- Alpha slab support- proposed locations are generally the same between schemes. Penetrations through support beams required where cable trays are to be re-instated through existing penetrations
- Hollow core support- locations are generally the same between schemes however the 40% scheme includes more extensive works that extend below the beam. All cable trays to be re-instated in new locations to accommodate strengthen works.
- Proposed strengthening works require removal of high voltage switchgear, transformers and high voltage cabling in basement and ground floor levels. Further structural detailed design with proposed works in these spaces reduced or excluded can be carried out. Implications to be worked through with Wellington Electricity.
- New dedicated Main Switchboard to be located on ground floor for essential and non-essential supply.
- New dedicated generator to be located on ground level.
- All existing electrical circuits to be pulled back to local distribution board, removed and replaced with new. Cable tray and containment may be reused and re-instated through existing penetrations or below strengthening works where necessary.

5.2.1 Base case & Market acceptable Upgrade

The base case option assumes the requirement to maximise re-use where possible of existing services. However, both schemes remain similar in terms of our recommendations for the works:

- Transformer and Switch Gear Room - Aurecon recommend a dedicated transformer to be provided to the Library as part of both schemes. The proposed strengthening works cannot be carried out without removing HV switchgear and transformers from their respective ground and basement plant rooms. Equipment within these spaces is owned and maintained by Wellington Electricity. Further review of the structural works in these spaces will be refined in future design phases, to understand if the impact to these services can be reduced, with implications to be worked through with Wellington Electricity.
- Main Switchboard- Aurecon recommend a dedicated main switchboard to be provided (above ground) to the Library as part of any works. The building currently has no dedicated Main Switchboard, instead relying on services from the Campus Main Switchboard located beneath the CAB building within the basement. All existing electrical and communications circuits, including cable tray/ containment to be pulled back to local distribution board, removed and replaced with new.
- Containment - Cable tray and containment may be re-used and re-instated through existing penetrations or below strengthening works where necessary. However, it is recommended all containment systems are removed to allow for more ready structural access. All containment systems (including re-used existing systems) will require new seismic bracing to current code requirements.
- Small Power - All existing electrical and communications circuits to be removed and replaced with new. Where new FRP is required on floors, this will required removal and replacement (with new) of floor boxes - requires further detailed structural analysis to confirm if these impacts can be minimised.

- Electrical Distribution Boards – Distribution boards are generally able to be re-used, but are considered at end of life and unreliable. Aurecon recommends replacing the existing switchboards complete with new sub-mains from the proposed new Main Switchboard.
- All lighting is generally at end of life. It is recommended to replace all lighting including exit and emergency lighting throughout the building.

Risks:

- Removal and isolation of 11kV equipment and cables to allow for strengthening works. The scope of these works will need to be confirmed through future design phases depending on the ability for the structural systems to avoid these areas. However, there is a significant risk that outages to HV equipment will be required, which would need to be negotiated with Wellington Electricity, and may potentially require amendments to the HV supply to the site to minimise impact to other network users.

Assumptions:

- New dedicated generator to be located on upper level to supply new essential services within the building. This is likely to require a dedicated housing with acoustic treatment and fuel storage facilities.
- Existing generator supplying campus to remain in current basement location and all cables to campus essential supply board to be removed to allow for strengthening works and re-instated.
- 11kV cables to MOB transformer room to remain in basement
- Penetrations in FRP for floor boxes to be re-instated- floor requires scanning to ensure that the prestressing strands in the floor are not cut. Structural framing may be required to support floor unit if floor boxes are not parallel to direction of hollowcore.
- All cable trays including 600mm wide can be re-instated through existing penetrations with penetrations added through proposed supports.
- Levels 3, 4 and locations on lower levels to have new suspended ceilings similar to existing ceiling. All areas where services are exposed are to remain exposed.

5.3 Separation of Services Implications

The following is a summary of the separation of services implications:

- Generator - Aurecon recommend a new dedicated standby diesel generator to be provided to the Library as part of the services separation from the Campus precinct. Cables from the existing generator to the Civic Main Switchboard in the CAB building basement requires removal and isolation for strengthening works to be carried out.
- Main Switchboard – It has already been recommended above that a new Main Switchboard is installed within the Central Library building as part of the seismic upgrade works.

6 ICT & Security Services

6.1 Condition Assessment Recommendations

6.1.1 Structured Cabling Systems (SCS) and Telecommunication Spaces

The Library has two fibre optic backbone connections to the rest of the WCC Campus precinct.

The Library has two main telecommunication cabling risers similar to the electrical submain distribution in North and South risers.

The distribution cabling is a mixture of Category 5e (CAT5e) U/UTP, CAT5 U/UTP and CAT6 U/UTP twisted pair. The structured cabling appears to have been partly replaced recently based on the type of cabling.

The Library has the telecommunication spaces and communication cabinets noted on the table below. The make of the cabinets is a mixture of ModemPak, Dell, Rittal and Europak suggesting some of the cabinets from original construction have been replaced at some point. Generally, the existing cabinets have between 5 and 15RU spare capacity.

Floor Level	Telecommunication Space Name	Cabinet
Ground	East	1 x 42 RU
	West	1 x 42 RU
Mezzanine	West	1 x 6 RU
Level 1	East	1 x 42 RU
	West	1 x 42 RU
Level 2	East	1 x 42 RU
	West	1 x 42 RU
Level 3	East	1 x 42 RU

The existing telecommunication cabling may be reused if the extent of the structural work is limited and telecommunication outlet locations remain unchanged. If the structural work is extensive involving removal of floor slabs, Aurecon recommends replacing all twisted pair telecommunication cabling with CAT6A F/UTP.

Aurecon recommends any new cabling to be CAT6A F/UTP to ensure cabling will be future proofed and providing better performance with the increasing demand of power of ethernet (PoE) devices and electromagnetic interference.

New CAT6A telecommunication cabling may not be accommodated within existing cable pathways such as skirting and cable trunking due to increase fill capacity and bending radius, and as such there will be needs to be some replacement of cable containment systems.

6.1.2 Access Control and Intruder Detection (ACID)

The security system is based on a Gallagher FT system with various controllers throughout the Library building floors. The main security control equipment is located in Level 1 of the MOB building and monitoring is carried out in the security control room.

Most of the devices are connected to the field controllers on the same level. The card readers are generally between Gallagher make. The passive infrared (PIR) detector make varies and dependent on the type of area covered.

The cabling consists of CAT5 and CAT6 twisted pair connected to the nearest dedicated security controller.

The CCTV cameras are centralised through the various network video recorders (NVR) with video management systems in the MOB building and report to control room operator desk monitors and wall monitors inside the MOB building Level 1 security control room. The CCTV camera coverage, make and condition is unknown.

6.2 Seismic Upgrade Implications

Refer to the attached drawings showing the high-level implications for each seismic upgrade option against this service category. The following summary observations are made:

6.2.1 Base case and Market Acceptable Upgrade

The base case option assumes the requirement to maximise re-use where possible of existing services. However, both schemes remain similar in terms of our recommendations for the works:

- All existing communications circuits to be pulled back to local floor distribution frames, removed and replaced with new. Cable tray and containment may be reused and re-instated through existing penetrations or below strengthening works where necessary. Aurecon recommends any all cabling to be CAT6A F/UTP to ensure cabling will be future proofed and providing better performance with the increasing demand of power of ethernet (PoE) devices and electromagnetic interference. There is a risk that new CAT6A telecommunication cabling may not be able to be accommodated within existing cable pathways such as skirting and cable trunking due to increase fill capacity and bending radius, and as such there may be a need to be some replacement of cable containment systems.
- Existing communications floor distributors may be able to be re-used, but it is generally recommended to replace with new. Based on this recommendation, we would be recommending the complete replacement of all existing structured cabling within the building, including distribution frames.
- The building currently has no main communications room, with systems connected back into the campus in a campus network. It is recommended a new main communications room is allowed for the building.
- Hardware including CCTV cameras and controllers to be removed to allow for strengthening works to be carried out and re-instated. Red Wolf (incumbent security advisor to WCC) advised hardware generally in good condition.
- The various controllers located throughout the Library building generally require removal to allow for strengthening works to be carried out and are to be re-instated in existing locations. Red Wolf advised hardware generally in good condition.

Risks:

- Should any communication equipment or cabling be maintained, there may be a risk with the compatibility with any existing equipment with new cabling and systems.

Assumptions:

- Main security control equipment located on Level 1 of the MOB building to remain in current location – no new dedicated system to be implemented.
- Penetrations in FRP for floor boxes to be re-instated- floor requires scanning to ensure that the prestressing strands in the floor are not cut. Structural framing may be required to support floor unit if floor boxes are not parallel to direction of hollowcore.
- All cable trays including 600mm wide can be re-instated through existing penetrations with penetrations added through proposed supports.
- Levels 3, 4 and locations on lower levels to have new suspended ceilings similar to existing ceiling. All areas where services are exposed are to remain exposed.

6.3 Separation of Services Implications

The following is a summary of the separation of services implications:

- Aurecon recommend allowing for new incoming telecommunication cabling from internet service providers directly from street to allow separation from the Campus precinct if required in future.
- Aurecon similarly recommend access control and intruder detection system to operate independently from Campus precinct in the future.

7 Vertical Transport

Aurecon do not have a condition survey for the vertical transport systems however we would recommend that as a minimum a full refurbishment should be allowed for all lifts and escalators.

We have not made any commentary regarding potential structural implications.

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