Minimum Design Standard – Hydraulic Services

1. Minimum Design Standard - Hydraulic Services

1.1 General Requirements

The purpose of this Minimum Design Standard is to set out Northern Territory Government (NTG) minimum requirements for the design of hydraulics for non-residential building projects1. All hydraulic services designs, including fire protection systems, are to comply with the NCC, the BCA, current relevant Australian Standards, Acts, Codes and Regulations applicable to the works, the requirements of the Building Certifier, the requirements of the Northern Territory Fire and Rescue Services Authority (NTFRS), the requirements of the PowerWater Corporation (PWC) and best practice.

Designs are to be forwarded to the Superintendent and the Client at 50%, 75% and 95% documentation stages.

Undertake a site inspection to locate all existing services and connection points. Show on the drawings all locations and levels, including existing and proposed ground levels, invert levels, lid and grate levels and dimensions of existing hydraulic infrastructure relevant to the works.

All statements made in this document are to be understood to be minimum requirements , unless specifically noted as otherwise. Guidelines for best-practice are provided over and above the minimum requirements for some design elements and these are clearly described as such, as well as specifying what is required from the design development process with respect to addressing those guidelines (for example a cost-benefit analysis may be required to assess the best-practice guideline, or a qualitative discussion provided in the design development report etc).

Unless otherwise approved, fixtures, fittings, and equipment are to be selected that are available through Northern Territory suppliers (including spare parts).

Any design aspects not specifically addressed by this minimum design standard must be identified by the designer and brought to the attention of the Superintendent for resolution during the design process.

The design and installation of Hydraulic services and equipment in buildings must comply with all current statutory requirements and current applicable Australian Standards.

The documentation must be quantitative, fully descriptive of all works to be undertaken, and able to be accurately quoted by contractors, with no ambiguity and no assumptions.

Allow for all design considerations described in this MDS that are required for a fully functional outcome of the final product as specified in the RFT/RFQ.

The design must be based on a full site investigation undertaken by the consultant and include all existing services, including backbone infrastructure, that must be installed, changed or upgraded to accommodate the proposed new works required of the design to be functional as intended.

The design must be sustainable, with the primary design criteria of longevity and minimum maintenance cost.

[1] The functional requirements of residential buildings significantly differ to those of non-residential buildings.

It is not acceptable to simply indicate that services shall be designed and installed to the requirements of a particular Australian Standard, this MDS, the NCC, or other documents. The designer must design the works so that the works will comply with the applicable requirements, and the designer must fully document the design.

The Master Specification for Major Building Works specifies the minimum requirements for construction works for the Northern Territory. The Master Specification should be used as the base template for the project. Edit it to suit the project.

Provide installation details on drawings.

Generic statements, such as *'Information for Design Intent Only'* on drawings for tender issue, are not acceptable. The tender drawings are to be the construction drawings.

1.1.1 Seismic restraint

Seismic restraint to AS 1170.4.

1.1.2 Technical Specification

The construction Technical Specification is the Master Specification for Major Building Works available via the DLI Project Manager for the contract. Read this section in conjunction with all other sections of this Minimum Design Standard and the relevant sections in the Master Specification for Major Building Works.

1.1.3 Co-ordination of designs across disciplines

Mechanical and hydraulics designers should discuss the possible provision of hot water from mechanical plant and any proposed use of heat pump hot water heaters.

The Mechanical Services designer is the lead designer in respect to co-ordination of designs for metering and monitoring, and Building Management Systems, across all 3 disciplines, Mechanical, Electrical, and Hydraulic. Provide design information to the Mechanical Services designer.

1.1.4 Designer Submissions – Plant and Equipment Schedules

As a minimum provide schedules giving information about all proposed items of plant and equipment.

For each item proposed the information provided must include, but not be limited to:

- Make
- Model name, designation, and number
- Size, including required clearances for installation
- Capacity of all system elements
- Performance characteristics related to all inputs, all outputs, and all the functions of the item
- Energy efficiency characteristics of proposed item and/or system
- Proposed location
- Country of origin and manufacture
- Materials used in the construction
- Certification of conformance to the applicable code or standard
- Assumptions
- Calculations
- Technical data schedules
- Manufacturers' technical literature
- Type-test reports
- Other information listed in this Minimum Design Standard as being required

1.2 Standards

Table – Referenced Australian Standards – Minimum Design Standard – Hydraulic Services	
Use Standards, and their amendments, current as at the date for the close of tenders except where different editions and/or amendments are specified or are required by statutory authorities, including, but not limited to, NATA and the National Construction Code which includes the Building Code of Australia and the Plumbing Code of Australia.	
Designation	**Title**
AS 1170	Structural design actions
AS 1170.4 (series)	– Earthquake actions in Australia
AS/NZS 1546 (series)	On-site domestic wastewater treatment units
AS/NZS 1546.1	- Septic tanks
AS/NZS 1546.3	- Secondary treatment systems
AS/NZS 1546.4	- Domestic greywater treatment systems
AS 2419 (series)	Fire hydrant installations
AS 2441	Installation of fire hose reels
AS 2698 (series)	Plastic pipes and fittings for irrigation and rural applications
AS 2698.1	- Polyethylene micro-irrigation pipe
AS/NZS 3500 (series)	Plumbing and drainage
AS/NZS 3500.0	- Glossary of terms
AS/NZS 3500.1	- Water services
AS/NZS 3500.2	- Sanitary plumbing and drainage
AS/NZS 3500.3	- Stormwater
AS/NZS 3500.4	- Hot water supply systems
AS 4032 (series)	Water Supply - Valves for the control of hot water supply temperatures
AS 4032.1	- Thermostatic mixing valves - Materials design and performance requirements
AS 4032.3	- Requirements for field testing, maintenance or replacement of thermostatic mixing valves, tempering valves and end of line temperature control devices
AS 4032.4	- Thermostatically controlled taps for the control of heated water supply temperatures
AS/NZS 5149 (series)	Refrigerating systems and heat pumps – Safety and environmental requirements
AS/NZS 5149.1	- Definitions, classification and selection criteria

1.3 Definitions and Acronyms

Table – Definitions and Acronyms – Minimum Design Standard – Hydraulic Services	
Term	**Meaning**
AAV	Air admittance valve
AHD	Australian height datum
BCA	Building Code of Australia - Volumes 1 and 2 of the NCC
BMS	Building management system
Central domestic hot water supply	Hot water heating equipment (hot water for personal use rather than air conditioning heating hot water) that supplies the majority of a building's hot/tempered water fixtures
Client	The department for which the project is undertaken by DLI
Day	Working days, not including Saturdays, Sundays and public holidays
Department, The	The Department of Logistics and Infrastructure – (formerly the Department of Infrastructure, Planning and Logistics (DIPL))
DHW	Domestic Hot Water
DIPL	The Department of Infrastructure, Planning and Logistics – (now the Department of Logistics and Infrastructure (DLI))
DLI	The Department of Logistics and Infrastructure – (formerly the Department of Infrastructure, Planning and Logistics (DIPL))
EoT/EOT	End of trip
FWG	Floor waste gully
HWS	Hot water system
IHWU	Instantaneous hot water unit
LGA	Local Government Area
LSI	Langelier Saturation Index
MDS	Minimum Design Standard
NCC	National Construction Code of Australia - includes the BCA and the PCA
NTFRS	Northern Territory Fire and Rescue Service
ORG	Overflow relief gully
PB	Polybutylene
PCA	Plumbing Code of Australia – Volume 3 of the NCC
PE	Polyethylene
pH	A measure of acidity or alkalinity
PWD	People with disability
SHW	Solar Hot Water
TDS	Total Dissolved Solids
WELS rating	Water efficiency rating for fixtures under the Australian Government Water Efficiency Labelling and Standards scheme

Table – Definitions and Acronyms – Minimum Design Standard – Hydraulic Services	
Term	**Meaning**
Wire-To-Water Pump Efficiency	The hydraulic power (W) imparted by a pump (pressure (kPa) x flow (l/s)) divided by the power consumed by the motor (W). This can be calculated by multiplying the pump efficiency (%) by the motor efficiency (%) at the dominant operating points of each
Provide	(a) Means give to the Superintendent where it refers to documentation. (b) Generally PROVIDE means, supply, transport, install, connect, test, commission and leave ready for use unless the context clearly indicates otherwise. In the context of this design standard this sense of PROVIDE means to incorporate these requirements in the design and specification documentation.
PWC	Power and Water Corporation
RFT/RFQ	Request for Tender / Request for Quotation - requirements applicable to one are equally applicable to the other
RPZD	Reduced pressure zone device
Shall	Is indicative of a mandatory requirement which must be incorporated in the design unless the context clearly indicates otherwise.
Superintendent	As defined in the contract. A reference to the Superintendent includes a reference to the Superintendent's Representative and to any person, or person occupying a position, nominated by the Superintendent, or by the Superintendent's Representative, to act on their behalf in procuring the works under the contract
TMV	Thermostatic mixing valve
WC	Water closet - a toilet pan
Will	Is indicative of a mandatory requirement which must be incorporated in the design unless the context clearly indicates otherwise.

1.4 Certification

All hydraulic design and documentation is to be certified by an engineer with appropriate qualifications recognised by the main authority regulating the discipline. The design must also take into consideration Fire Safety.

1.5 Building Management System (BMS)

Allow for any mechanical devices, sewer pumps, water pumps, irrigation systems and tank level indicators to be connected to new or existing Building Management System (BMS).

1.6 Drawings

1.6.1 General requirements for drawings

The floor plan scale is to be a minimum1:100.

Use standard symbols and terminology from AS/NZS 3500 parts 0, 1, 2, 3, and 4 on the drawings and in the documents.

The following elements must be shown on the drawings as a minimum:

a. all stacks,
b. all inspection opening points,
c. all overflow relief gullies (ORGs) and disconnector gullies,
d. elevated pipework,
e. cold water reticulation and outlet points,
f. hot water reticulation and outlet points,
g. tempered water reticulation and outlet points,
h. locations of temperature tempering devices,
i. fire hydrant system piping, connection points and outlet points,
j. fire hose reels locations and connection points,
k. rainwater collection and disposal systems including roof guttering, connection points, inspection openings, downpipes, underground disposal piping, on ground kerbs, gutters, channels, including sizing of elements,
l. grey water reticulation, connection points, disposal points, treatment points,
m. recycled water reticulation, collection points, disposal points, treatment points,
n. backflow prevention devices,
o. Landscape irrigation system connection points to the potable water main.

1.6.2 Requirements for 50% drawings

a. A record of all observations made on site (all existing services and connection points, locations, levels, including existing and proposed ground levels, invert levels, and dimensions of existing hydraulic infrastructure relevant to the works),
b. General design outline of proposed infrastructure,
c. Adequate detail for Superintendent and client to be able to give approval of proposed design,
d. Provide minutes from Authority consultation meetings (PWC, NTFRS and Environmental Health),
e. Provide a service capacity report,
f. Provide a brief report on co-ordination with other disciplines' drawings,
g. All services must be shown on the drawings in their proposed positions with clearly shown connection points and connection types,
h. Site specific conditions are to have been allowed for and must be acknowledged on site plans and other drawings if relevant and in specifications,
i. All drawings must be developed based on industry best practice for construction and design with minimal future maintenance in mind,
j. The design and the drawings must reflect what is required by the Client as detailed in the design brief.

1.6.3 Requirements for 50% design report

a. Domestic hot water load calculations,

b. Domestic hot water predicted daily hot water hourly demand histogram,

c. A completed solar hot water heater system or heat pump design spreadsheet (where relevant)

1.6.4 Requirements for 75% drawings

a. Mark-ups and comments from 50% documentation must have been incorporated in to these drawings,
b. Drawings to show defined plan of proposed layout of infrastructure including details of the infrastructure,
c. All stakeholders input should be completed and required changes incorporated with fixture types and positions finalised (including positions of ORGs, TMVs and Vents),
d. All services must be shown on the drawings in their proposed positions with clearly shown connection points and connection types,
e. Provide a brief report on co-ordination with other disciplines' drawings,
f. All drawings must clearly show invert levels and reference levels to AHD where applicable,
g. Site specific conditions are to have been allowed for and must be acknowledged on site plans and other drawings if relevant and in specifications,
h. All drawings must be developed based on industry best practice for construction and design with minimal future maintenance in mind,
i. Drawings must reflect what is required by the Client as detailed in the design brief and as further developed after the 50% submission.
j. Schedule of fixtures to be included noting WELS ratings of proposed selections (or minimum WELS ratings required of contractor selections, as appropriate).)

1.6.5 Requirements for 95% drawings

a. Mark-ups and comments from 75% documentation must have been incorporated in to these drawings.
b. Provide copies of approvals from Authorities (PWC, NTFRS and Environmental Health).
c. Provide a brief report on co-ordination with other disciplines' drawings.
d. Services to be shown on the drawings showing positions and clearly stating any extra requirements (e.g. TMV lockable box, connection to plaster trap , position of refrigeration unit for drinking troughs) and clearly showing connection types and position.
e. Schedule of fixtures to be included noting WELS ratings of proposed selections (or minimum WELS ratings required of contractor selections, as appropriate)
f. All drawings submitted to the Superintendent for checking must have been checked for compliance by an appropriately qualified engineer before submitting them to the Superintendent.
g. 95% complete set of hydraulic plans are to have been signed and approved by a Hydraulic engineer and must have a Section 40 design Certificate.

1.6.6 Construction Request For Tender (RFT)

Hold points must be included in RFT documentation and must clearly indicate when Hydraulic inspections are required.

Refer to document titled Inspection Process Hydraulic Works Overview, in a zip folder linked under the heading *Hydraulic design and Hydraulic works inspection process*, under the heading *Minimum design standards and supporting documents*.

- For Hold Points refer to Section 1.
- For Sewers/Drains refer to Section 2.
- For Water, Wastes, and Stacks refer to Section 3.
- For Final inspection refer to Section 4.

Each Section has a companion check list and/or report Form included in the zip folder.

1.7 Specific Requirements

Confirm the Hydraulic services requirements with the Superintendent. The Hydraulic Consultant is to forward requests for information to the Superintendent.

Develop a drainage plan which takes into consideration foundations/footings design, slab design, proposed landscaping, external ground levels, access for people with disabilities, and Power and Water requirements.

1.7.1 Sewerage Design;

a. Locate the sewerage connection point on site and show the location and depth (below ground level or RL or AHD) on the design drawings.

b. Show locations of new ORGs on the drawings.

c. Locate any existing ORGs on site and show them on the drawings. Indicate on the drawings if the existing ORGs are compliant or not.

d. An existing compliant ORG which covers multiple buildings on the same parcel of land must be indicated on the Hydraulic Plans or Site Plan showing its position, which buildings are connected to it and its current compliance status.

e. An existing ORG which is not compliant is regarded as a disconnect gully. If any exist on site, show their locations on the drawings and show what is connected to them.

f. At least one ORG must be installed in the drain except as provided in Clause 4.6.6.2 of AS/NZS 3500.2.

g. All ORGs to be charged by a fixture. Charging by a hose cock is a last option.

h. A compliant ORG position mustbe indicated on the drawings.

i. Do not assume there is a compliant ORG on an existing site.

j. Where pump stations / pump wells are installed ORGs must be installed to the drain. Pump stations / pump wells and ORGs must be fully compliant.

k. Each new building included in the works must be protected by its own ORG, including where multiple buildings are located on a common parcel of land. Each ORG should serve one building only.

l. A reflux valve must not replace an ORG at any time unless with the approval of Hydraulics DLI.

m. Measure invert levels on site and show invert levels on the drawings.

n. Design the sewer system as a gravity system not as a rising main system. A rising main system would be a last resort alternative. Obtain Superintendent's approval to design the system as a system other than a gravity system before commencing design of the alternate type of system.

o. All underground drainage pipework below ground level must be 100mm diameter minimum with exception of shower and basin to a floor waste.

p. All condensate pipes connected to the sewerage system to be lagged and are to be shown on the drawings.

q. Use chrome plated metal floor wastes, grates and inspection openings internally. Use metal floor wastes and grates and inspection openings in exterior locations. These are to be shown on the drawings.

r. In Plant Rooms where the air conditioning unit does not run for 24/7, each floor waste trap receiving discharge from plant and/or equipment requires an electronic fixture primer valve connected to keep the trap full of water.

s. Within the building, all tundishes are to be rebated stainless steel units with a glass front, 40mm outlet and fully insulated, including waste pipe, to floor level. If a trap is required a waterless trap with a stainless steel removal cover is to be used under the tundishes.

t. Do not use AAVs. Use positive venting throughout. Where AAVs are proposed the designer is to provide a report on the need and benefits for their incorporation before incorporating them into the design.

u. Additional inspection openings may be required for public buildings, schools, prisons, hospitals, health clinics etc.

v. A clothes washing machine must not discharge into a Floor Waste Gully (FWG).

w. A laundry tub receiving the waste from a washing machine must not discharge to a FWG.

x. Inspection openings will be required in close proximity to every W.C as close as practical to the pan in all public buildings, schools, hospitals, health clinics etc. Inspection openings are required at every change of direction of sewerage lines inside the building.

y. Inspection openings in sensitive, secure areas will be at the direction of the governing body.

z. All sewerage outside the Lot involving Power and Water must have separate drawings which must be submitted to, and be approved by, Power and Water.

1.7.2 Overflow Relief Gullys

AHD reduced levels are required for ORGs and must be shown for:

a. The Finished Ground Level adjacent to each ORG,
b. The grate of the ORG,
c. The Finished Floor Level for the lowest fixture connected to the sanitary drain. See AS/NZS 3500.2 Clause 4.6.6.6: For the NT the minimum height between the top of the overflow gully riser and the lowest fixture connected to the drain is 100 mm, and
d. The top of the ORG and for the lowest fixture connected to the sanitary drain.

1.7.3 Grease traps for food preparation

All grease traps are to be constructed of reinforced, Sulphur resistant, concrete, with a minimum compressive strength of 32MPa, and be fitted with air tight heavy duty lids.

a. Use PWC guidelines for grease trap requirements design and installation regardless of whether the system is connected PWC network or not. All grease trap installations and designs must comply with AS/NZS 3500.2, Installation of pumps section. All tanks, risers and precast products are to have structural and hydraulic certificates of Compliance to AS/NZS 1546.1.
b. Grease traps must be located on site in a position accessible from the outside of the building without need to interrupt any services and which is easily accessible for tanker vehicle access.
c. Refer to the Code of Practice for On-Site Wastewater Management published by NT Environmental Health.
d. Gas Tight lids are required on all Grease traps.
e. A suitably sized vent must be installed to vent the Chamber directly.
f. Grease trap outlets are to have a trap sampling point including a gas tight access cap.
g. Grease traps are to be designed to be as close as possible to the fixtures to be serviced.
h. Venting of the sampling point is not required if apparatus is located externally.

1.7.4 Plant rooms

a. Provide a tundish in the plant room to accept discharge from condensate lines.
b. All floor wastes receiving discharge from plant equipment require an Electronic timer controlled priming device.
c. Trap priming devices are to discharge to the tundish in the plant room.
d. All condensate lines to discharge to a tundish in the plant room.

1.7.5 Septic and aerated sewerage treatment systems and secondary treatment systems

a. Design sewerage treatment, secondary systems and septic systems to suit the project actual usage.
b. The sewage treatment and secondary system design must be in accordance with Department of Health Code of Practice for On-site Waste Water Management and, where required, Draft Guidelines for Wastewater Works Design Approval for Recycled Water Systems.
c. All pump stations are to be constructed of reinforced, Sulphur resistant, concrete, with a minimum compressive strength of 32MPa, and be fitted with air tight heavy duty lids.
d. All sewage treatment/septic installations and designs will comply with AS/NZS 3500.2, Installation of pumps section. All tanks, risers and precast products are to have structural and hydraulic certificates of Compliance to AS/NZS 1546.1.
e. Do not use plastic, poly or fibreglass sewerage treatment structures.
f. Conduct an assessment of the absorption conditions prior to designing absorption trenches as per Department of Health requirements.
g. Provide a hose tap adjacent to the treatment system. Install a Reduced Pressure Zone Device (RPZD) upstream of the hose tap as a backflow prevention device.
h. Refer to the Code of Practice for On-Site Wastewater Management published by NT Environmental Health.

1.7.6 Requirements for On-site Domestic Sewerage Treatment Plants and Septic Design

Details required on Design Drawings:

a. Owner name and location of premises,
b. Real property description,
c. Site plan showing location and footprint of buildings and dimensions from boundaries,
d. Show street/road names for street/roads inside the property boundary, if any, and for the streets/roads outside the property boundary but adjacent to, or close to, the property boundary, especially those streets/roads which provide access to the property,
e. North point (all views to be orientated with north point to top of sheet), and
f. Dispersal Area calculation showing the site supporting the proposed installation type, depth of soil and depth of inverts.
g. Refer to the current Code of Practice for On-Site Wastewater Management published by NT Environmental Health.
h. Design Consultant needs to complete a DLR/DIR (Design Load Rating/Design Irrigation Rating)

1.7.7 Flows

Details required in documentation:

a. Secondary treatment system – manufacturer's name and system model name,
b. Type of disposal area: evapotranspiration,
c. Sub-surface irrigation to a designated wastewater effluent re-use area,
d. Sectional details of wastewater effluent re-use area,
e. Note any retaining structures and any areas of fill, both existing and proposed,
f. Site slope contours to be shown, both existing and proposed,
g. Domestic water sources (underground pipe if within 6.00m of the disposal area),
h. Depth to water table at location of disposal area (if less than 1.50m below ground surface),
i. Methods proposed to prevent surface run-off entering the disposal area (i.e. Diversion Mound),
j. Dimensions from boundaries, building(s), water courses, gullies, and water sources on project site property and on adjoining properties,
k. Required fencing, and
l. Distances from bores.

1.7.8 Pumps and Pump Wells

a. All pump station installations and designs must comply with AS/NZS 3500.2, Installation of Pumps section. All tanks, risers and precast products are to have structural and hydraulic certificates of Compliance to AS/NZS 1546.1.
b. All sewage pump station designs are to be accordance with *WSA 04-2005 Sewage Pumping Station Code of Australia v2.1*.
c. All pump stations are to be constructed of reinforced, Sulphur resistant, concrete, with a minimum compressive strength of 32MPa, and be fitted with air tight heavy duty lids.
d. All pump stations will have a minimum 80mm vent.
e. The gravity discharge to the pump station must be located at least 100mm above the highest working level and terminate with a square junction.
f. The lowest float will be set to stop pumping prior to pumping water below the top of the pump.
g. External switch board cabinets must be manufactured in Stainless Steel

h. All pumps are to be selected with consideration of maximising the wire-to-water efficiency at the design flow and pressure conditions. A minimum benchmark wire-to-water efficiency of 50% must be observed. The contractor is to provide pump curves for each unit, marked up with the wire-to-water efficiency at the system's design operating point.
i. All pumps with an absorbed power greater than 1.0 kW at the design operating point must be variable speed (except where the projected duty (i.e. pressure and flow) on the pump can be shown to be consistent across all operating conditions).

1.7.9 Cold Water Service;

The minimum requirement for PE water supply piping DN 110 or less, to be SDR 11 –PN 16HDPE PE100.

PE piping to AS/NZS 4130.

All water services pipes, including fire services pipes, which pass through directionally bored passages below ground must be encased within a suitable conduit.

Materials

Services to be constructed from materials as listed below unless specified otherwise or noted otherwise on the drawings
Provide a simple table indicating materials to be used for all components listed below. Refer to the example table below. Ensure all materials selected are acceptable.

A simple materials matrix table, located in general hydraulic Notes, indicating the materials of the following components:

1. Sewer Drainage
2. Sewer Plumbing
3. Rising Main
4. Exposed Wastes (C/Plated)
5. Cold Water (in Ground)
6. Cold Water (internal)
7. Hot Water/ Warm Water (internal)
8. Fire Service (in Ground)
9. Fire Service (above Ground)
10. Stormwater
11. Trade Waste

Example Table

Table – Materials of Components – Minimum Design Standard – Hydraulic Services		
SERVICE	**MATERIAL**	**REMARKS**
Cold water (in ground)	PN 16 HDPE PE 100	Fusion welded

Requirements

a. Design cold water supply to suit available pressures: Remote area water pressure operates around 90 to 120 kPa. Contact Power and Water for information about available pressure in these areas.
b. Design cold water services not to run in or under slabs. If there is no alternative the following requirements apply:
   - pipe must be full length, without any joins, and be made of copper, or stainless steel, or Rehau polymer material.
   - laid in a conduit of sufficient size to enable the removal of the pipe and lagging contained in it,
   - pipe to be lagged.
c. Select flushing apparatus to suit low pressures or design a break tank and pressure system to suit fixtures operating with higher pressure requirements than the pressures which are available.
d. Design water services to suit the quality of the water to be used. eg. Low ph requires all metal components to be stainless steel and pipework to be PB or PE not copper.
e. All isolation valves on branches are to be stainless steel ball valves from 50 mm to 12 mm.
f. Trap priming devices to be electronic timer controlled type.
g. Thermostatic mixing valves and tempering valves must be indicated on the water plan where required.
h. Containment devices must be indicated on the hydraulic cold water drawings.
i. Closest tap to a grease trap must have a suitable containment valve, which is to be indicated on the drawings.
j. Vented Containment devices located internally must have a suitable method controlling the spill from the exhaust ports.
k. Pipe sizes must be clearly marked on the plan.
l. Use Pentair Valve Check range of low pressure backflow devices. Ensure this requirement is marked on the drawings.
m. A hose tap must be provided adjacent to effluent treatment systems and grease traps. A Reduced Pressure Zone Device (RPZD) must be installed immediately upstream of the hose tap as a backflow protection device.

1.7.10 Hot Water Service;

Design to AS 3500.4.
HWS overflows and requirements for Safe trays to be shown on plans.

Water pipes for heated water in a non-circulatory heated water service must be designed to;

a. Reduce to a minimum the amount of dead (cold) water drawn off before hot water commences to flow at any tap,
b. Be sufficient to give the required flow at all outlets (including branches from non-circulatory services),
c. Be by the shortest practical route for the main flow heated water pipes and branches to the heated outlets,
d. Be the minimum necessary diameter required to supply the outlet draw off; and provide a water velocity not exceeding 3 m/s,

Design hot water services to not run in, or under, slabs. If there is no alternative the following must apply:

e. pipes must be full length without any joins,
f. pipes must be laid in a conduit of sufficient size to enable removal of the pipe, insulation and lagging contained in it,
g. pipes must be lagged, and
h. pipes must be insulated with appropriate insulation to AS/NZS 3500.4.

Circulating Loops

Hot water circulating loops are a source of thermal loss in a building. The decision on whether a circulating loop is required will be determined by the application of AS/NZS 3500.4, which considers requirements for limiting the length and capacity of a heated water dead leg.

AS/NZS 3500.4 Clause 10.9.3.2 (Length and capacity of dead leg with meter) refers specifically to heated water supplying an apartment, dwelling or secure area and requires a branch offtake to be as close as practicable to the area it serves.

Note 5 of this clause requires that the volumetric capacity of any dead leg, measured from the branch offtake at the circulatory flow to its outlet, should not exceed 2L.

While the above clause may be interpreted to address a service with a hot water meter only, the requirement is a useful parameter which must be used to determine when a circulatory system is required in any NT Government building design covered by this MDS.

Figure Q.3 of the standard provides a worked example of how to calculate the volume of a dead leg, for different pipe materials, limiting any dead leg volume to 2L.

Where appropriate, limit recirculating loop lengths by using Point-of-Use water heaters for outlying fixtures such as kitchenette sinks.

Adequate provision must be made for thermal expansion of pipework, with reference to AS/NZS 3500.4 Clause 4.13.3.

1.7.11 Tempered Water Service

a. Design to AS/NZS 3500 Parts 1, 2, and 4.
b. Thermostatic mixing valve (TMV) designs must comply with AS 4032 series - Water Supply - Valves for the control of hot water supply temperatures.
c. Installation must conform to AS/NZS 3500.4 - Hot water supply systems.
d. The inlet hot water temperature to TMVs must not exceed the recommendation of the TMV Manufacturer.
e. Where concealed, the locations of the TMVs must be identified with clear signage in a visible location to ensure servicing personnel are able to locate the devices.
f. TMVs must be mounted at a maximum height of 1.6 metres from the floor slab for ease of access for maintenance.
g. Do not use standard tempering valves. where Thermostatic mixers are required according to AS 3500
h. There is a requirement to rationalise the number of TMVs for reasons of capital cost and associated maintenance. The designer is to consider allocating TMVs to serve multiple fittings or outlets, provided the flow and pressure of these fittings meets the minimum performance requirements under code, and that the sequential operation of the additional fittings introduces a variance of no more than 10% of each fitting.
i. Generally the maximum total pipe length from TMV to the most disadvantaged fixture must not exceed 10 meters.

1.7.12 Hot Water Generation System Design

1.7.12.1 General Considerations

Hot water storage temperature
DHW generated at NT Government facilities should be stored at a minimum of 65°C. Note this exceeds the minimum temperature required by AS/NZS 3500.4, however provides a factor of safety against the development of legionella in public facilities.

To reduce legionella risks, power to domestic hot water storage-based systems must not be turned off after hours.

Facility Categories
Domestic Hot Water (DHW) consumption and load profile characteristics are considered in the following facility categories:

a. Diverse dispersed small loads
Facilities in this category are generally office or public type buildings which operate during business hours only, with no residential accommodation. DHW fixtures are limited to hand basins in NCC Climate Zone 3, cleaners sinks, tea station sinks and possibly People-with-Disability (PWD) showers.

There is typically no discernible peak DHW consumption period during the day, however if an End-of-trip (EOT) facility is present, a morning shower peak may be observed coinciding with the start of the business day.

b. Diverse hand basin dominated loads
Facilities in this category are categorized by multiple hand basins that use DHW, in addition to amenity hand basins, and may include buildings such as Health Centres with consulting rooms, and Laboratories, including teaching laboratories.

c. Simultaneous shower-dominated small to medium loads
Facilities in this category include buildings with showers, several of which may be used simultaneously. Examples of these are sporting facility change rooms, facilities with amenities for shift workers, and buildings with residential accommodation.

Consider that designs of remote school systems may need to consider daily student showering programs.

A one-hour morning and evening peak will generally be experienced in smaller facilities. Peaks in larger installations could extend to 2 hours.

d. Large diverse loads
Large, multi-use facilities such as hospitals and correctional centres fall into this category. These buildings will usually include additional DHW loadings from commercial-scale laundries and kitchens. Hot water consumption and load profiles are often determined by operational controls that are imposed, eg showering regimes that are imposed in correctional centres.

Hot Water Heating Equipment Types
Required technology for different applications and locations is outlined in the table below. LSI refers to Langelier Saturation Index and should be calculated for the water temperature experienced at heating elements/surfaces.

REQUIRED HOT WATER HEATING TECHNOLOGY[1,2]

FACILITY TYPE	Standard water quality areas (with LSI greater than -1 and less than 0.4)	Areas with LSI less than -1 or greater than 0.4
DIVERSE DISPERSED SMALL LOADS Office Courthouse School/training centre/child care (excluding sports facility showers) Museum/art gallery Climate controlled store/archives Data warehouse/server room Research farm Ranger station (non-residential buildings)	<500L/day: IHWU per fixture >500L/day: IHWU or Solar thermal	<500L/day: IHWU per fixture - if allowed by warranty conditions (eg. some three phase units) Closed loop solar thermal (preferred) or point-of-use electric storage for small loads. In Alice Springs and Tennant Creek, where residential-type solar thermal system tank capacities are insufficient to achieve near 100% solar contribution, use ground level tanks and a closed loop to potable water heat exchanger.
DIVERSE HAND BASIN DOMINATED Laboratories Health centres		
SIMULTANEOUS SHOWER Sports facility change rooms Fire station change rooms Multiple dwelling/room residential facility (eg. boarding house) Camping ground shower blocks Ambulance stations Police stations		
LARGE DIVERSE LOADS Hospitals Correctional facilities	For large diverse load systems, heat pump technology shall be used where a solar contribution greater than 60% is not achievable unless otherwise approved by DIPL.	Alice Springs: use closed loop systems with heat exchangers: - solar thermal with ground level tank/s if >60% solar contribution possible; or - heat pumps Use closed loop solar thermal in other locations.

Notes

[1] Unless otherwise approved as per DIPL MDS exemption approval process and delegations outlined in internal DIPL Sustainable Design Strategy.

[2] It is the Designer's responsibility to ensure selected equipment is appropriate for the expected water quality, and that equipment water quality warranty conditions are met.

Water Quality Considerations
Designers are to review the most recent **Power and Water Corporation Annual Drinking Water Quality Report** and ensure equipment, pipes and fixture selection is appropriate for the water quality at the project location.

Water quality, as it relates to durability of water heating equipment, is determined by several chemical characteristics. These are:

a. pH (potential of hydrogen)
b. Total hardness
c. Total dissolved solids
d. Conductivity
e. Alkalinity
f. Water temperature (of the heated water)

Varying combinations of the above characteristics can promote corrosion of surfaces or the formation of limescale.

The Quality Report referenced above publishes tables of Average Hardness, pH and TDS for urban centres and remote communities. These can be quickly referenced as an indication of the likely water quality at the site. Also included are comprehensive Water Quality Results for each urban centre and remote community in the Northern Territory.

The designer must present a water quality impact on equipment selection assessment of the site to DLI that refers to at least the following:

a. pH
b. Langelier Saturation Index (LSI) based on water temperature experienced at the equipment water heating surface, pH, hardness factor and alkalinity factor) – this index is a good indicator of whether scaling will be problematic
c. TDS

These may be easily referenced or calculated from the Quality Report. For larger installations, it is recommended that laboratory testing be completed to confirm water quality.
For ease of reference, LSI's for water at 60 degrees Celsius has been calculated for various locations based on information in the Power Water 2022 Drinking Water Quality Report.

Urban Centres and Towns

Table – LSIs for selected locations – Urban Centres and Towns			
LGA	**LSI**	**LGA**	**LSI**
Adelaide River	0.9	Katherine	-0.3
Alice Springs	0.9	Katherine Surface	-2.0
Batchelor	0.7	Kings Canyon	0.3
Borroloola	0.4	Larrimah	1.6
Cox Peninsula	-3.2	Mataranka	1.3
Daly Waters	1.4	Newcastle Waters	1.5
DARWIN	-0.9	Pine Creek	-0.3
Elliot	1.6	Tennant Creek	1.1
Garawa	-1.6	Ti Tree	1.4
Gunn Point	-0.8	Timber Creek	1.2

Remote Communities

Table – LSIs for selected locations – Remote Communities			
Community	**LSI**	**Community**	**LSI**
Acacia Larrakia	1.1	Maningrida	-4.0
Ali Curung	-0.2	Manyallaluk	-4.4
Alice Springs	1.2	Milikapiti	-4.3
Alpurrurulam	1.6	Milingimbi	-2.3
Amanbidji	1.7	Milyakburra	-3.1
Amoonguna	0.9	Minjilang	-3.5
Ampilatwatja	1.7	Minyerri	0.2
Angurugu	-3.5	Mount Liebig	1.2
Areyonga	1.7	Nauiyu	0.4
Atitjere	1.7	Nganmarriyanga	0.6
Barunga	-3.1	Ngukurr	1.6
Belyuen	-2.6	Nturiya	1.3
Beswick	1.1	Numbulwar	1.5
Binjari	1.2	Nyirippi	1.6
Bulla	0.3	Papunya	2.0
Bulman	-0.2	Peppimenarti	0.3
Canteen Creek	1.1	Pigeon Hole	1.0
Daguragu	1.5	Pirlangimpi	-3.4
Darwin	-1.1	Pmara Jutunta	1.2
Engawala	1.6	Ramingining	-2.9
Finke	0.6	Rittarangu	1.2
Galiwinku	-3.5	Robinson River	2.0
Gapuwiyak	-3.3	Santa Teresa	1.3
Gunbalanya	-4.1	Tara	0.7
Gunyangara	-2.1	Tennant Creek	1.1
Haasts bluff	1.7	Titjikala	1.0
Hermannsburg	1.6	Umbakumba	-3.2
Imangara	1.4	Wadeye	-4.3
Imanpa	1.9	Wallace Rockhole	1.1

Table – LSIs for selected locations – Remote Communities			
Community	**LSI**	**Community**	**LSI**
Jilkminggan	1.9	Warruwi	-3.4
Kalkarindji	1.3	Weemol	1.3
Kaltukatjara	1.3	Willowra	1.5
Katherine Surface	-2.0	Wilora	1.4
Katherine	-0.2	Wudapuli	-2.8
Kintore	0.7	Wutunugurra	0.8
Kybrook farm	0.6	Yarralin	1.6
Lajamanu	1.0	Yirrkala	-3.0
Laramba	1.4	Yuelamu	0.4
		Yuendumu	1.7

When selecting water heating plant, the designer must confirm with plant suppliers which components and materials are appropriate to the water quality determined.

For example:

a. Stainless steel tanks are suitable for a pH level between 6.0 and 8.5
b. Vitreous enamel-lined tanks are suitable for a TDS < 2,500mg/L
c. Open-loop, direct-connected solar collectors must only be used for a Langelier Saturation Index between -1 and 0.4. Closed-loop, indirect-connected collectors must be used outside this range.
d. Heating elements and anode selections are determined by LSI and TDS respectively.

For larger installations, consult with DLI whether a water treatment plant should be incorporated in the design.

General Load Estimation (considering Northern Territory Climate Zones)

Whilst designers retain responsibility for the functionality of their designs, Minimum Design Standard contents on load estimation and design tools/spreadsheet tools are provided on the Technical Specifications web page as optional tools to assist designers.

The Northern Territory falls within Climate Zones 1 and 3, as applied by the NCC. These are described as:

a. Climate Zone 1 - high humidity summer, warm winter
b. Climate Zone 3 - hot dry summer, warm winter

The **ABCB** publishes a Climate Zone map, which locates Local Government Areas by zone as follows:

Table – Climate Zones Applicable to Towns and Regions			
LGA	**Climate Zone/s**	**LGA**	**Climate Zone/s**
Alice Springs	3	Litchfield	1
Barkly	3	MacDonnell	3
Belyuen	1	Palmerston	1
Central Desert	3	Roper Gulf	1
Coomalie	1	Tiwi Islands	1
Darwin	1	Victoria – Daly	1,3
Northern Territory Rates Act 1971 Area	1	Wagait	1
East Arnhem	1	West Arnhem	1
Katherine	1		

Hot water consumption from certain hydraulic fixtures is affected by ambient air temperature. For instance, building occupant use of hot water in showers during summer in Climate Zone 1 is less than in Climate Zone 3 and conditions are never cold enough in Climate Zone 1 to justify warm water in NT Government facility amenity hand basins. Accordingly:

- Lower DHW loads result from showers in Climate Zone 1 compared to Climate Zone 3; and
- Hot water must not be provided to amenity hand basins in Climate Zone 1.

Typical load characteristics and load calculation inputs are given in the tables below for Climate Zone 1 and Climate Zone 3.

NT GOVERNMENT FACILITY TYPICAL LOAD CALCULATION INPUTS, CLIMATE ZONE 1

FACILITY TYPE	NCC Climate Zone 1	
	Typical DHW fixtures	**Typical DHW load profile characteristics & usage**
DIVERSE DISPERSED SMALL LOADS Office Courthouse School/training centre/child care (excluding sports facility showers) Museum/art gallery Climate controlled store/archives Data warehouse/server room Research farm Ranger station (non-residential buildings)	Tea station sinks Cleaners sinks PWD showers EOT showers	3.8L/person/day, 18L/shower use/day, 8-hour day (business hours), EOT 1-hour shower peak
DIVERSE HAND BASIN DOMINATED Laboratories [1] Health centres	Clinical hand basins Laboratory sinks Tea station sinks Cleaners sinks PWD showers	8.8L/person/day, 18L/shower use/day, 8-hour day (business hours)
SIMULTANEOUS SHOWER Sports facility change rooms Fire station change rooms Multiple dwelling/room residential facility (eg. boarding house) Camping ground shower blocks Ambulance stations Police stations	Amenity hand basins Amenity showers Baths Tea station sinks Cleaners sinks PWD showers	<u>Residential:</u> 115L/person/day, 2 x 1-hour peaks <u>Other:</u> 38.8L/person/day, 18L/shower use/day, 2 x 1-hour peaks
LARGE DIVERSE LOADS [2] Hospitals Correctional facilities	Sanitary fixtures Commercial Laundry equipment Commercial kitchen appliances Workshop fixtures	High diversity of fixture loading, Continual (24/7) operations, Sanitary fixtures subject to morning and evening peak loading <u>Hospitals</u> 135L/bed, peak duration to be assessed on project <u>Correctional Facilities</u> 20L/inmate, 2 x 2 hour peaks, to be assessed on project

Notes

[1] Laboratories with specialist water requirements such as laboratory grade or deionised water services, or with specialist equipment such as sterilisers or washer-dryers should be considered separately.

[2] Hot water loading and characteristics shall in the first instance be based on project specific parameters including occupancy, operational controls, equipment etc.

NT GOVERNMENT FACILITY TYPICAL LOAD CALCULATION INPUTS, CLIMATE ZONE 3

FACILITY TYPE	NCC Climate Zone 3	
	Typical DHW fixtures	**Typical DHW load profile characteristics & usage**
DIVERSE DISPERSED SMALL LOADS Office Courthouse School/training centre/child care (excluding sports facility showers) Museum/art gallery Climate controlled store/archives Data warehouse/server room Research farm Ranger station (non-residential buildings)	Amenity hand basins Tea station sinks Cleaners sinks PWD showers EOT showers	5L/person/day, 23L/shower use/day, 8-hour day (business hours), EOT 1-hour shower peak
DIVERSE HAND BASIN DOMINATED Laboratories[1] Health centres	Amenity hand basins Clinical hand basins Laboratory sinks Tea station sinks Cleaners sinks PWD showers	10L/person/day, 23L/shower use/day, 8-hour day (business hours)
SIMULTANEOUS SHOWER Sports facility change rooms Fire station change rooms Multiple dwelling/room residential facility (eg. boarding house) Camping ground shower blocks Ambulance stations Police stations	Amenity hand basins Amenity showers Baths Tea station sinks Cleaners sinks PWD showers	<u>Residential:</u> 115L/person/day, 2 x 1-hour peaks <u>Other:</u> 40L/person/day, 23L/shower use/day, 2 x 1-hour peaks
LARGE DIVERSE LOADS[2] Hospitals Correctional facilities	Sanitary fixtures Commercial Laundry equipment Commercial kitchen appliances Workshop fixtures	High diversity of fixture loading, Continual (24/7) operations, Sanitary fixtures subject to morning and evening peak loading <u>Hospitals</u> 135L/bed, peak duration to be assessed on project <u>Correctional Facilities</u> 20L/inmate, 2 x 2 hour peaks, to be assessed on project

<u>Notes</u>

[1] Laboratories with specialist water requirements such as laboratory grade or deionised water services, or with specialist equipment such as sterilisers or washer-dryers should be considered separately.

[2] Hot water loading and characteristics shall in the first instance be based on project specific parameters including occupancy, operational controls, equipment etc.

1.7.12.2 Centralised Hot Water System Load Estimation

Centralised system loads and patterns of hot water use are to be determined by estimating the following:

a. Maximum and average daily demand (L/day)
b. Peak hot water flow (L/s)
c. Operating period of the building (hrs)
d. Number of peaks of hot water use (no)
e. Duration of peak (hrs)
f. Time between peaks, which informs the recovery rate (hrs)
g. Building thermal losses, including in recirculation system/s (kWh/day)

Hot water consumption is typically calculated from the number of occupants in a building, rather than the number of hydraulic fixtures. There may be exceptions to this, for example laboratories, where hot water consumption may be dominated by sustained use of certain fixtures, in this case lab sinks, irrespective of the number of building occupants.

Where building occupancies are not confirmed, estimations may be made by applying the NCC occupancy rates for the respective type of building.

The following are to be provided to DLI for review by the Design Development (50%) design phase:

- A load calculation reflecting the above, and
- A predicted daily hot water hourly demand histogram (noting design tool available for use on the Technical Specifications web page.

1.7.12.3 Solar Hot Water (SHW) System Design

Design to **AS/NZS 3500.4** (Refer Section 6: Installation of Solar Water Heaters)

Whole-of-life and greenhouse gas emissions analyses have confirmed that maximising solar hot water heating contribution is generally the most cost effective and low-carbon technology option where space and project budget is available.

In addition, a review of the value of roof space use for photovoltaic panels, compared to use for solar thermal hot water heating panels, found that more greenhouse gas emissions can be saved using available roof space for solar thermal rather than photovoltaic panels (and other means can be used to source renewable electricity). This is due to the much greater efficiency with which solar thermal panels convert solar radiation to useful energy compared to photovoltaic panels.

As such, DHW systems using SHW are to be designed to maximise (achieve close to 100%) solar contribution wherever possible.

Where a minimum of 60% solar contribution from a SHW system is not possible, designers are to seek DLI approval to use a heat pump system instead. The Minimum Design Standard exemption approval process and delegations are outlined in the internal Sustainable Design Strategy.

Solar System Component Sizing

The Solar Hot Water System Design Spreadsheet Tool is intended as a guide to assist designers maximise the solar contribution and minimise electric boosting as follows:

a. Enter location, average daily hot water demand to be supplied by SHW, ambient temperature and number of fixtures to be supplied by SHW.
b. Work with architects to determine the maximum space available for solar hot water (SHW) plant, comprising tank/s, solar collectors, including on rooftop where applicable. Where tank storage

volumes exceed typical domestic SHW storage capacities, storage tanks must be located at ground level in a secure outdoor plant area.

c. Select storage tank size and number to calculate stored volume of hot water possible for the building, up to the maximum required to meet the building's daily hot water demand (aiming for 100% theoretical solar contribution in item 4.15 of the tool).
d. Select ratio of tank volume to collector area (this factor may be adjusted in an iterative tool completion process).
e. Check area of solar collectors is appropriate to tank volume (refer AS/NZS 3500.4 6.3.1, Note 3), and available roof area.
f. Determine and enter Daily Solar Radiation at site from AS/NZS 3500.4 Figure G.3(B)
g. Review ratio of tank volume to collector area to improve theoretical Solar Contribution to 100% if possible (refer d. above).
h. Determine Anticipated Solar Fraction (%) at the Site from AS/NZS 3500.4 Fig. G.1. The anticipated solar fraction as defined in AS/NZS 3500.4 is the percentage total hot water energy delivered before the purchase of supplementary energy, considering local and meteorological conditions.
i. Size electric boost to meet the peak building hot water demand. Consider first hour demand and hourly recovery rate of heater(s).
j. Select SHW system with a return water inlet where recirculating loop is required.
k. A completed solar hot water heater system design spreadsheet (where SHW is to be used) is to be provided to DLI for review by the Design Development (50%) design phase

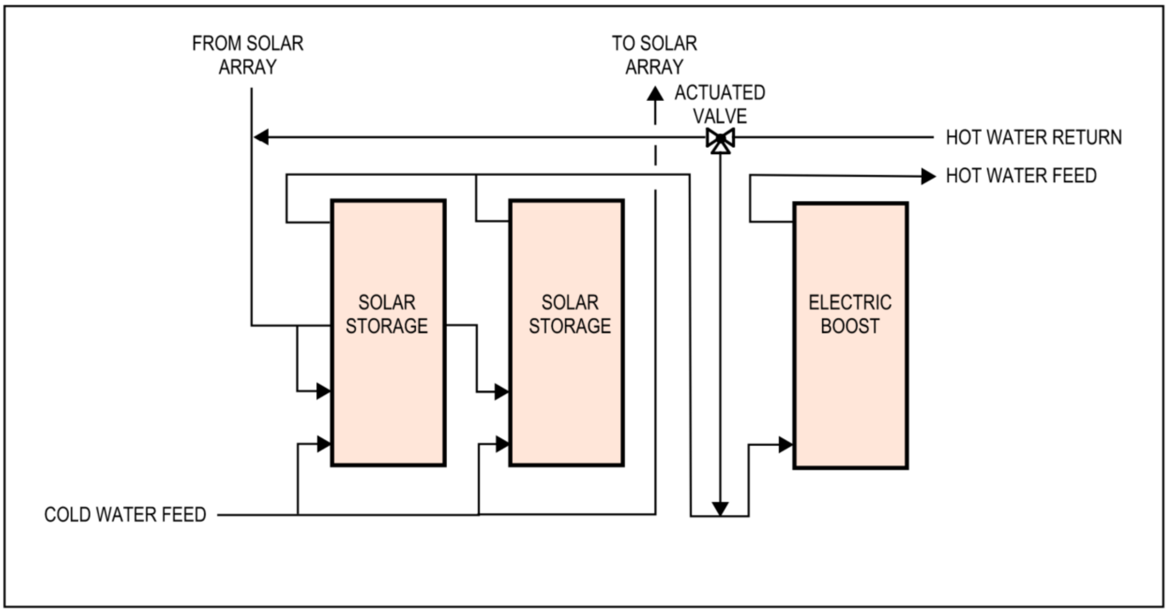
General Design Requirements

a. All equipment must be WaterMark certified as required by **NCC Volume 3 (PCA)**.
b. Storage tanks must be stainless steel or other material as required by water quality (refer to clause 1.7.12.1 above).
c. Minimise distance between tanks and collectors.
d. Where roof slope is less than ten degrees or not well orientated, solar collectors must be installed on frames to achieve the optimum inclination and must be protected by hail/stone guards.
e. Maximise area of collectors to be north-facing and inclined within 20° of the local latitude angle, installed in equal arrays.
f. Install stone-guards over solar thermal panels (50x50x3mm galvanized mesh on 50x50 angle frame; rubber or nylon spacers required to separate frame from roof sheeting).
g. In locations with high an LSI below -1 or above 0.4 (refer section **1.7.12.1** above), specify closed-loop SHW systems. Refer to the most recent Power and Water Corporation Annual Drinking Water Quality Report to check the LSI for the project location.
h. Confirm with the supplier that the selected SHW plant is appropriate for the expected LSI water quality and ambient temperatures experienced at the site – including that warranty conditions can be met.
i. In facilities which may have periods of no load (including being closed, like school holidays or over weekends), SHW components may become overheated, since sufficient heat rejection in direct, open-loop domestic hot water system may not be available. This can lead to what is known as solar stagnation, which can damage collectors and pipework. Designers are to ensure solar stagnation

risks are minimised, for example through selection of indirect closed-loop systems and/or additional over-heating prevention measures.

j. A current switch with run lamp must be installed in a prominent location within the administration area of the building to indicate when the electric boost is operating.

k. Designs are not to use electric boosters for anything other than assistance when solar radiation is reduced due to cloud cover etc. The line diagram below gives an example of an acceptable configuration where a temperature actuated valve will divert the building hot water return through the solar storage when there is sufficient energy available, without any boost heating. When insufficient solar energy is detected in the solar storage tanks, the hot water return is diverted through the electric boost to maintain temperature of the recirculation loop.



Note that for smaller, domestic-type installations, the electric boost component is often combined with the solar storage component in a common tank.

1.7.12.4 Heat Pump System Design

Equipment that uses refrigerants with a Global Warming Potential (GWP) > 700 are not to be specified.

Heat pumps up to 40 kW are to use refrigerants with a GWP < 10.

For each application, designers are to:

a. Check the availability of the proposed refrigerant in the NT, in sufficient quantities for maintenance and re-charging; and

b. Investigate the availability and potential use of equipment using non-HFO (PFAS containing) refrigerants with a GWP less than 10 - for example R290 (propane) and R744 (carbon dioxide).

To assist designers, a list of known commercial heat pump models available in Australia that can deliver water under and over 65°C, excluding those that use refrigerants with a GWP > 700, is available on the Technical Specifications web page. Note the heat pump market is rapidly changing and the list may not reflect all available options that meet DLI's requirements. Designers must check availability with suppliers.

Suppliers can ask that the market research information be updated by emailing AssetManagement.DIPL@nt.gov.au.

Depending on capacity, type of demand and climate zone, the options are air-to-water or water-to-water heat pumps.

Water-to-water heat pumps should be considered in those applications where a reliable source of heating injection is available (for example mechanical source from HVAC systems like condenser water systems or chilled water return to district cooling chiller plants). In this case, there might be the opportunity to use the same heat pumps to produce heating hot water for space heating and domestic hot water.

Consider:

a. Where a large air-sourced heat pump system for low temperature space heating is available, the air-sourced heat pumps could be used in cascade with water-to-water heat pumps to boost hot water temperature for domestic use.

b. Where a multivalent air-sourced 4-pipe chiller system for space cooling and heating is available, the 4-pipe chillers could be used in cascade with the water-to-water heat pumps to boost hot water temperature for domestic use.

Air-to-water heat pumps should be considered in all other cases. In this case, there might be the opportunity to use the same heat pumps for space heating and domestic hot water.

System Component Sizing

The Heat Pump System Design Spreadsheet Tool is intended as a guide to assist designers in sizing heat pump and storage systems as follows:

a. The building hot water characteristics and load must be calculated as described in **1.7.12.2** above.

b. With reference to the hourly demand histogram, derive the maximum peak demand and the minimum recovery between peaks.

c. Select hot water storage tank(s) to provide the maximum peak demand volume.

d. Calculate the heating capacity required in kW over the recovery period (hrs), for the required temperature rise (°C).

e. Consider the recirculation thermal loss in the building by calculating the hourly recirculated flow between the start of successive peaks i.e., for the peak duration and the recovery period.

f. Calculate the heating capacity required in kW over this time, to recover the expected temperature loss in the recirculation system.

g. Determine appropriate number of heat pumps for the system, considering redundancy and available heat pump capacities. Refer to list of available suppliers on the website.

h. Select a preferred operational load (%) appropriate to the selected heat pump(s). Especially for combined mechanical and domestic systems, capacity and number of heat pumps should consider part load operation for optimum heat pump COP and range of operation.

i. Check that an appropriate factor of safety, typically 10%, of capacity compared to demand.

j. For multiple heat pumps, check the system redundancy capacity should one of the largest heat pumps on duty fail with the remaining operating at 100%. Typically, the system should be selected to maintain minimum 50% redundancy in case of failure of one of the largest heat pumps on duty.

k. Check the system hot water flow capacities (L/s) at the preferred operational load, and at 100% operational load.

l. A completed heat pump system design spreadsheet (where heat pumps are to be used) is to be provided to DLI for review by the Design Development (50%) design phase

Air-to-Water System Specific Design Requirements

a. Check system required hot water temperature, especially for combined mechanical (heating/dehumidification reheat) and domestic hot water use. Air-sourced heat pumps with synthetic refrigerant can usually operate at a maximum of 65°C heating hot water temperature. Natural refrigerant type heat pumps (hydrocarbons, carbon dioxide etc.) should be considered for higher operating temperature.
b. Check with selected equipment supplier if/how outside air temperature range affects operation. For climate zone 3, maximum design ambient temperature may be found to be limited to 35°C for stable operation, with maximum operating ambient temperature usually limited to 45°C. In climate zones 1 and 2, there is no expected limit of operation of minimum temperature.
c. Check with selected equipment supplier that equipment can operate with the predicted delta T between supply and return temperature and if/how storage tank stratification can be used to meet delta T requirements.

Water-to-Water System Specific Design Requirements

a. Minimum water temperature on the heating injection side is usually limited to 10°C. Lower temperature may have detrimental effects on efficiency and stability of operation, with increased risk of failure.

General Design Requirements

a. All equipment must be WaterMark certified as required by **NCC Volume 3 (PCA)**. This includes any components in contact with DHW, eg plate heat exchangers.
b. Storage tanks must be stainless steel or other material as required by water quality (refer to clause 1.7.12.1 above).
c. Comply with **AS/NZS 5149.1** with respect to equipment selection, system design, safety classification, refrigerant charge, application, and location of plant.

1.7.12.5 Under-bench Boiling and Chilled Water Unit (BCWU) Selection

For the selection of under-bench boiling and chilled water units consider the following:

a. The number of building occupants expected to access each unit must be determined. This will allow the appropriate capacity of unit to be selected based on expected cups of boiling and chilled water per day. Units that are undersized for the number of users may not deliver an acceptable temperature of chilled water throughout the day. Units that are oversized will expend more energy than necessary to meet the chilled water demand and will incur a higher capital cost than necessary.
b. During commissioning, operating modes of units must be set to a ‘sleep’ or ‘economy’ mode, which powers down the unit during periods of non-use.
c. Units must be powered off by means of a timer, in government facilities which are closed over the weekend.
d. Provision must be made for ventilation of joinery where air-cooled systems are selected.

1.7.13 Fire Hydrants and Fire Hose Reels

Fire Hydrants to AS 2419 and to NTFRS requirements.

Fire Hose Reels to AS 2441 and to NTFRS requirements.

Fire Hose Reels to be designed where possible to come off of the fire ring main.

For Fire Hose Reel services, within the building, which are to be designed to be connected to the domestic supply, the following should be considered in design:

a. Each branch line off the domestic water supply main to domestic fixtures must have a ball valve on the branch line as close as possible to the main,

b. All ball valves must have identifying tags in a prominent position and which shows their location if the ball valves are concealed,

c. Design to comply with AS 2441.

1.7.14 Cross Connection Control and Backflow Protection (Backflow Assessment)

The Hydraulic Consulting Engineer (accredited backflow assessor) is responsible for assessing backflow risks to the site (low, medium or high) to all apparatus, fixtures, and equipment on the site according to AS/NZS 3500.1, and must include Fire services, including Fire Hose Reels, and all applicable items listed in AS/NZS 3500.1, Appendix F, Table F1 and Table F2.

Power and Water backflow assessment at the boundary connection must be the same value as the highest rated internal device.

1.7.15 Stormwater and Subsoil Drainage

a. Storm water system design generally must comply with AS/NZS 3500.3 - Stormwater

b. Drainage design: To the NCC (the PCA and the BCA) and Local Authority by-laws.

c. All storm water systems to use sewer grade pipes.

d. All storm water systems to AS/NZS 3500.3 or Engineer's specification

1.7.16 Minimum WELS rating requirements

All fixtures must meet the following minimum WELS rating requirements. Aerators are not to be used in fixtures in hospital clinical areas. Exceptions may be considered for specialist equipment where compliant options are not available. All exceptions are to be specifically reviewed and approved prior to selection. Where exceptions have not been specifically reviewed and approved, the following minimum requirements apply:

a. Lavatory equipment – 4 Stars WELS
b. Tap equipment – 5 Stars WELS
c. Urinal equipment – 4 Stars WELS
d. Showers – 3 Stars WELS
e. Flow controllers – 5 Stars WELS

1.7.17 Avoidance of exposure to biofilms

a. Design pipework as straight as possible and avoid dead legs and stretches of pipework that do not recirculate
b. Where dead legs cannot be avoided, restrict to as short a length as possible
c. A flushing facility must be provided where there is low draw off and fixtures that are seldom used must be placed on flow lines or close to regularly used services
d. Avoid sink and hand basin taps that drop water directly into the drain where they can aerosolise stagnant water microorganisms

1.7.18 Metering

The hydraulic design must include provision of meters to cover:

- Central domestic hot water supply (either electricity or gas as per the fuel source)

Where the installation incorporates a new or existing BMS system, connect the meters into the BMS system to facilitate the monitoring of the magnitude and pattern of energy consumption.

Hydraulic design documentation must include documentation of the metering systems provided under the scope of the hydraulic design and must be coordinated with the mechanical design to ensure a consistent approach to metering documentation with a consistent naming convention.

In general - The requirements of NCC2019 Part J8 apply. The lead responsibility for the metering system shall be under the mechanical design. The hydraulic design must be coordinated with other services designs to ensure the following requirements are met using BACnet compatible equipment.

Minimum metering requirements are:

Table – Minimum Design Standard – Electrical Services – Minimum metering requirements	
Incomer check meters	15 minute (minimum) interval data, meter specifications equivalent to Power and Water Corporation smart billing meter requirements (at minimum, must record kWh, kVA, kW, kVAr and power factor and retain data for at least 12 months)
Sub-system meters	15 minute (minimum) data kWh or MJ, smart meter (same specification as incomer check meters preferred)

For buildings that require a sub-metering system under NCC J8.3(b), and for any building with a central plant HVAC configuration, the sub-metering system must have remote access capability and independently capture the following end use categories:

- Incomer check meter(s)
- Chillers
- Chilled water plant ancillaries (i.e. pumps and cooling towers)
- Heating hot water generators
- Heating hot water system pumps and ancillary loads
- Fan coil units and air handler fans
- Artificial lighting
- Appliance power
- Central hot water supply (domestic)
- Lifts and other internal transport devices

- Diesel generator electricity production
- Solar PV electricity generation
- Other ancillary plant

Note that metering requirements for the above categories are to be understood as a requirement to capture the aggregate of all units within the category. It is not the intention to individual sub-meter each individual unit in each category.

1.7.19 Remote area tapware

Quarter turn taps are to be specified in remote areas.

1.8 Irrigation

1.8.1 Backflow prevention

Fit a backflow prevention device; To AS/NZS 3500.1 and as required to meet the approval of Power and Water Corporation (Pentair Valve Check or equivalent).

1.8.2 Irrigation controller

The irrigation controller is to be compatible with the Building Maintenance System and is to include the following features:

a. Variable timer for each station with a range from 1 minute to not less than 60 minutes,
b. Manual cycle and individual station operation,
c. Manual on-off operation of irrigation without loss of program,
d. 240 V input and 24 V output capable of operating 2 control valves simultaneously,
e. 24 hour battery program backup,
f. Power surge protection.

1.8.3 Electrical connection:

a. Connect to a 240 V supply.

b. Provide an isolating switch at the controller.

1.8.4 Automatic control valves:

a. 24 V solenoid actuated hydraulic valves with flow control and a maximum operating pressure rating of at least 1 MPa.

b. Provide valves able to be serviced without removal from the line.

c. Install a gate valve of the same size as, and immediately upstream from, each automatic control valve.

d. Valves 40mm and above no more than one solenoid valve to be installed per valve box

e. For 25mm valves no more than 2 solenoid valves to be installed per valve box “JUMBO” valve boxes must not be used.

1.8.5 Valve boxes

a. Use micro irrigation valve boxes which are of high impact plastic with snap lock covers at finished ground level, each housing a stop cock, filter (200 mm for microsprays, 100 mm for drippers), pressure reducing valve (170 kPa outlet pressure) and automatic control valve.
a. Boxes supported on all sides by bricks or pavers

b. Boxes lined with geo textile fabric to avoid ingress of soil
c. Base of box lined with min 50mm gravel for drainage
d. Minimum 50 mm clearance between gravel layer and irrigation item (eg valve)
e. Minimum 50 mm clearance between bottom of lid and irrigation item (eg valve)
f. Final height of top of box to be flush with soil surface in lawn areas and 50 mm higher than finished grade in gardens horizontal alignment to be parallel with surrounding ground
g. Box must not to come in contact with irrigation item or pipe

1.8.6 Control wires:

a. Connect the automatic valves to the controller with building wire laid in sealed conduits, with the mainline where possible.
b. Lay control wires intertwined for their full length without joints except within valve boxes.
c. Use waterproof connections.
d. Provide expansion loops at each solenoid lead or joint.
e. Backfill trenches only after inspection and approval of wiring.
f. Minimum size active 1.5 mm^2.
g. Minimum size common 2.5 mm^2 laid in closed loop.

1.8.7 Sprinkler Heads

Provide heads which maintain a pre-set arc of throw, which are adjustable for radius during watering operations and which are vandal-resistant.

1.8.8 Pop-up type heads:

Use heads designed to rise out of their housings under supply pressure to a minimum "pop-up" height of 50 mm.

1.8.9 Risers

Mount all in-ground heads on reticulated risers. Mount above ground heads on fixed risers.

1.8.10 Micro irrigation system

Polyethylene irrigation pipe

a. To AS 2698.1 Class IRRIG with barbed fittings of similar pressure rating fastened with ratchet type clamps.
b. Lay pipe on finished ground surface under planting bed mulch and anchor at minimum 1.5 m intervals with U-shaped stakes.
c. Connect micro-tube laterals with proprietary push in or screw in fittings.

Microsprays

Mount microsprays on stakes 300 mm above ground and connect to the pipework with microtubes.

Drippers

Use drippers which are turbulent flow types, easily dismantled for cleaning.

Connect directly into the pipework or with microtubes.

NORTHERN TERRITORY GOVERNMENT