The Autism Friendly School

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Abstract

Children on the autism spectrum often struggle to cope with over-stimulating environments (Tufvesson and Tufvesson, 2009) (Gaines et al., 2014) (McAllister, 2010). This can make learning in mainstream primary schools difficult, as students risk being excluded from learning activities. This research suggests that adjustments to mainstream primary school classrooms are necessary to improve learning outcomes and asks, how can the mainstream primary school provide better learning environments for students on the spectrum?

A literature review and analysis of precedent studies provide the background for this research. Surveys of existing classrooms, questionnaires, and focus groups with teachers are the primary data sources. Design is a vital component of the research process and an essential tool for generating discussion in the focus groups.

Analysis of the primary data, together with findings from the literature review and precedent studies, are brought together to inform the development of a design guide. This guide is tested through the formulation and iteration of numerous design proposals, focusing on the remodelling of classrooms in existing primary schools in NZ. Design proposals for new learning environments are also developed and discussed.

The outcome of this research is a design guide that will be essential reading for those involved in the provision and design of learning environments in New Zealand primary schools. It is envisaged that not only students on the autism spectrum will be positively impacted by implementing the architectural solutions outlined in the guide, but all students will benefit.

Preface

As someone with autism, I've had personal experience dealing with the condition while growing up and attending school. Over time I learnt to deal with the traits associated with autism and have been able to cope in many different environments. However, many other individuals on the spectrum have a worse experience with their surroundings.

This research's inspiration came from reading articles online of students with autism who cannot cope in modern learning environments. It became apparent that the design of these spaces was not conducive to such students' sensory needs. This situation reflects how architecture has failed to accommodate people with neurological disabilities. Consequently, I was motivated to discover how architectural design could improve these students' learning outcomes.

I hope that the profession and society will take more significant consideration of hidden disabilities in the future.

Acknowledgments

Adele, thanks for being the best supervisor anyone could ask for. Your persistent encouragement and guidance made a world of difference, and I can't thank you enough.

My family for always being interested in my studies and providing love and support.

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Thanks to all the participants who gave their time for this research. Your feedback and your enthusiasm were much appreciated.

Additional thanks to all the principals that allowed me to visit their schools and shared their knowledge.

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Introduction

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1.1 Background

Autism or autism spectrum disorder (ASD) is a neurodevelopmental condition that affects communication, social interaction, and adaptive behaviour. ASD is an umbrella term that covers the subgroups of autistic disorder; Asperger's disorder (Asperger syndrome), childhood disintegrative disorder (CDD), and pervasive developmental disorder not otherwise specified (PDD-NOS) (MoE, 2016 p.11).

Autism is defined as a triad of characteristics: social impairment, communication impairment and repetitive behaviours (Mostafa, 2018, p.309). It is a diverse condition; therefore, the individuals affected have a wide range of severity, disability and intellectual function (MoH&E, 2016, p.25). Boys are four times more likely to develop autism than girls (MoH&E, 2016, p.26). The cause of autism is not known, although scientists believe that genetics and environmental influences are likely involved (Altenmüller-Lewis, 2017, p.S2226).

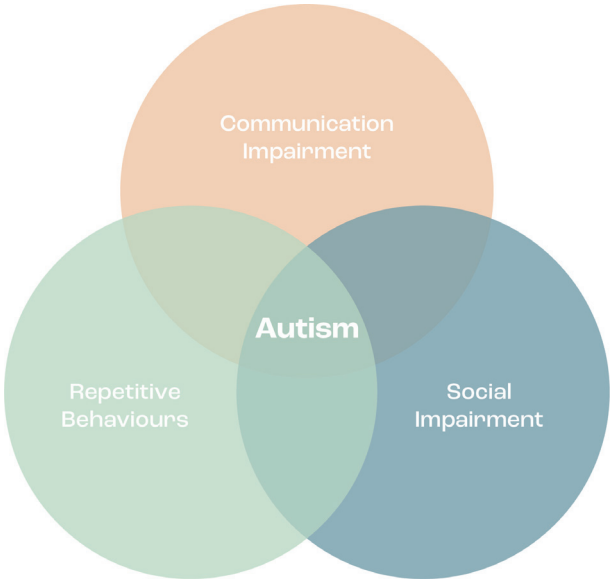


Figure 1. The Triad of impairments

Approximately 80,000 individuals in NZ have autism (Autism NZ), although many may not be diagnosed (MoH&E, 2016, p.26).

According to international trends, the occurrence of autism is rising. In the US, an estimated 1 in 54 children have been diagnosed with ASD (CDC, 2020), compared to 3 per 1,000 children in the 1990s (Blaxill, 2004, p.536). Similar increases have also been documented in Japan, Europe, and the UK. It is unknown whether this is due to an actual increase in incidence, or broadened awareness and detection of autism (Gaines et al., 2016, p.25).

1.2 Issue

Children on the autism spectrum often struggle to cope with over-stimulating environments. Environmental and physical factors such as noise, lighting and colour can have a cumulative effect and disrupt learning activities (Tufvesson and Tufvesson, 2009) (Gaines et al., 2014) (Mcallister, 2010) meaning that autistic students are disadvantaged.

In NZ, this problem is apparently being exacerbated by modern (or innovative) learning environments. The associated open-plan spaces have led to autistic students being unable to manage to work properly and, in some instances, exhibiting behavioural problems. According to Autism NZ, half of all students being expelled in NZ schools are on the autism spectrum, with modern learning environments partly to blame (Jones).

In 2016, a government-initiated review also raised concerns about the suitability of MLEs for autistic students due to instances of anxiety being triggered by sensory sensitivity (Yang, 2017, p.33).

Architects can support autistic students in their education by accommodating their needs in the built environment's physical design. Designing the mainstream learning environment to be more autism-friendly gives students on the spectrum a much better chance at school, and non-autistic students can also benefit from this approach because it improves the architecture quality (Shell, 2016, p.8).

1.3 Research question

“How can the mainstream primary school provide better learning conditions for autistic students?”

1.4 Aim and objectives

Aim:
To discover how the education of autistic students in NZ can be improved through the mainstream primary school's physical design.

Objectives:
1. Investigate autism, and research autism-friendly design.

2. Create a design guide to inform the design of autism-friendly primary schools in NZ.

3. Develop and test design solutions for existing and new learning environments.

1.5 Methodology

The background analysis includes a literature review on autism theories, education guidelines and autism design research from overseas. Precedent studies include mainstream and special needs schools from NZ and overseas. A survey of existing classrooms in two schools in Wellington, in addition to questionnaires and focus groups with teachers, serves as the main source of primary data for this research.

Analysis of the primary data, together with findings from the literature review and precedent studies, is brought together to inform the development of a design guide. The guide is targeted towards architectural designers and includes a comprehensive range of recommendations for designing learning environments that accommodate the needs of students on the autism spectrum. This guide is tested through the formulation and iteration of numerous design proposals, which focus on the remodelling of classrooms in existing primary schools in NZ. Design proposals for new learning environments are also developed.

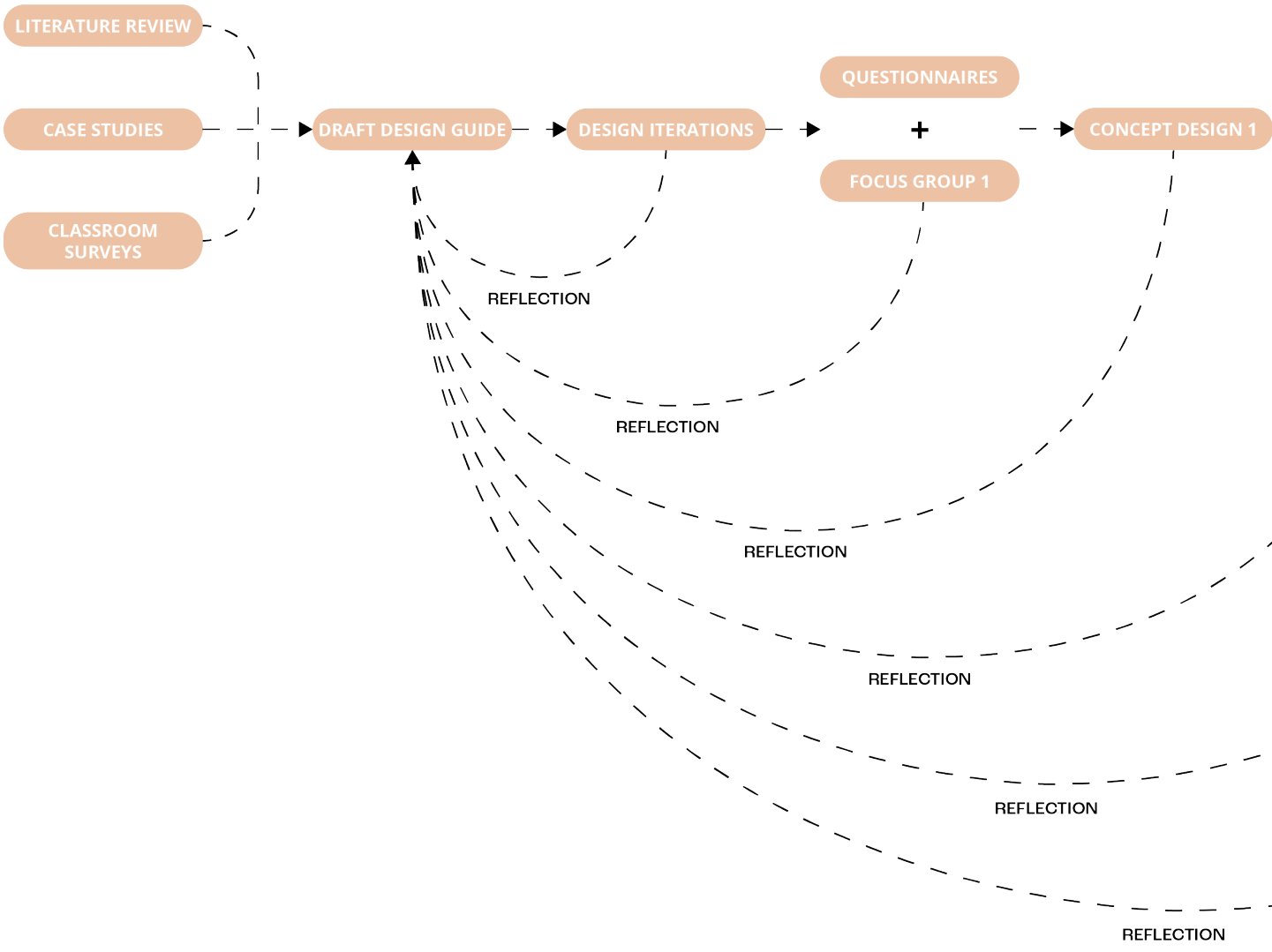
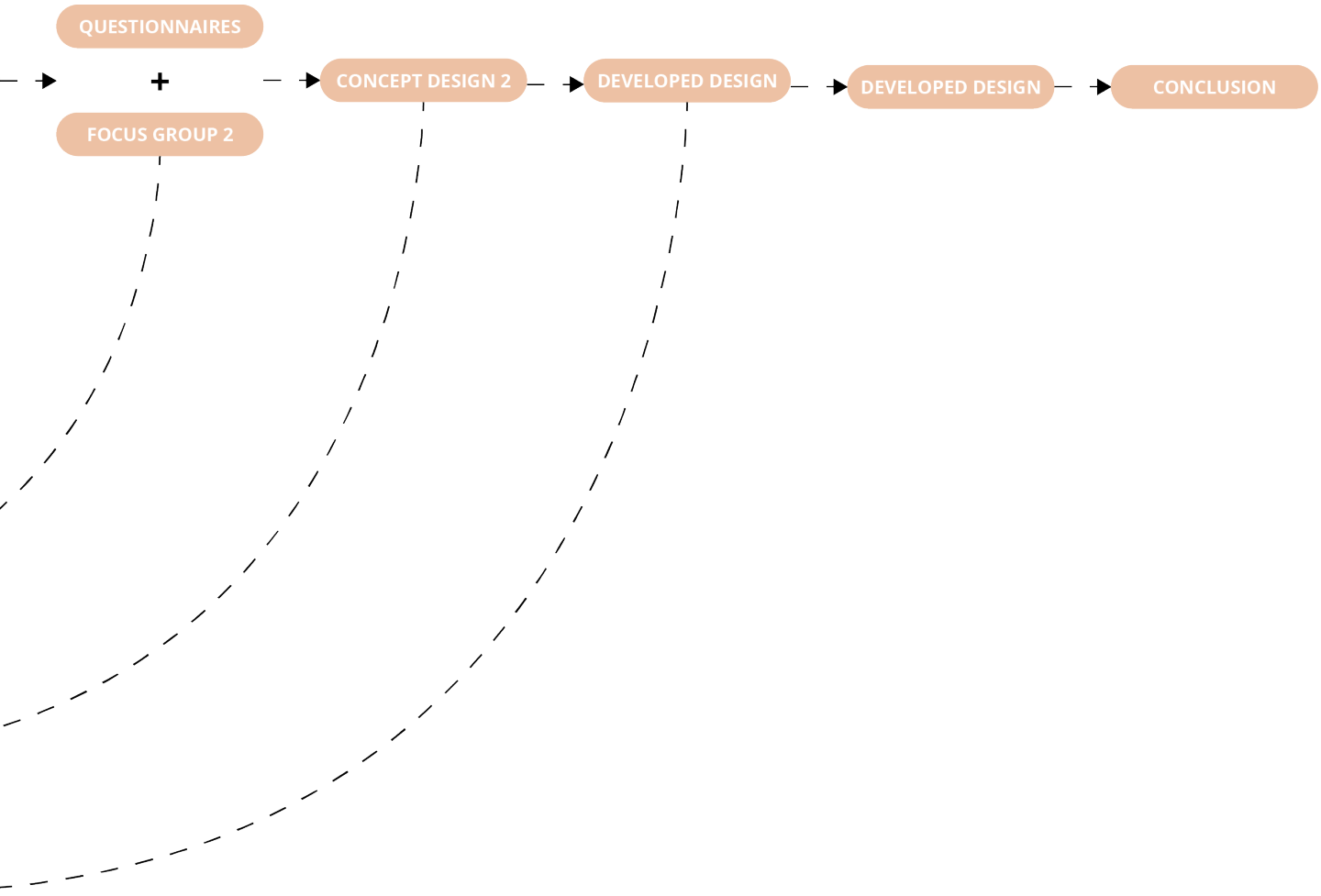


Figure 2. Methodology diagram


QUESTIONNAIRES
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FOCUS GROUP 2
CONCEPT DESIGN 2
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DEVELOPED DESIGN
CONCLUSION

Literature review

2

2.1 Autism traits

People on the autism spectrum often have difficulties processing sensory information from the surrounding environment. Sensory integration is the ability to receive information about a space using all five senses. It is essential for generating a coherent perception of a situation and deciding how to act. The sensory integration of autistic people is hindered, which manifests in hypersensitivity (over-reaction) or hyposensitivity (under-reaction) to stimuli. Individuals with autism can find it difficult to rapidly shift their attention between two different stimuli, leading to unusual behaviours (Gaines et al., 2016, p.25).

Most individuals on the spectrum are either hypo-sensitive or hyper-sensitive to sensory information in their surroundings (Gaines et al., 2016, p.25). People with hypo-sensitivity often create their own sensory experiences for pleasure or to block out other unwanted stimuli. On the other hand, children with hyper-sensitivity can become easily overwhelmed by sensory information, and their surroundings can become distressing. It is common for people on the spectrum to experience sensory overload when attempting to use more than one sense. (Gaines et al., 2016, p.26).

Repetitive, rigid behaviour is another characteristic of autism. Examples of this behaviour include finger clicking, rocking, or tapping objects. A child may exhibit repetitive behaviour to generate a sensory experience or comfort them due to sensory overload. 'Stimming' is a rare yet harmful type of repetitive behaviour that involves self-injurious body movements like headbanging (Gaines et al., 2016, p.26). This behaviour could be due to the individual wanting to block out confusing sensory stimuli in their environment (Gaines et al., 2016, p.27).

The desire for a predictable routine and physical environment is common among individuals on the spectrum. A desire for sameness can apply to minute details in the person's surroundings. A disruption to a person's routine can cause them to become upset (Gaines et al., 2016, p.28).

Individuals on the spectrum also experience difficulties with communication and social interactions. Children with autism may struggle to make friends because of their highly structured and inflexible nature of play. This leads to autistic children missing out on social play's benefits, such as learning appropriate distances from others. Future development, self-esteem and coping with stressful events are also impacted by not having close friendships (Gaines et al., 2016, p.28).

Children with autism often avoid social interactions, preventing them from developing social skills (Gaines et al., 2016, p.28). Part of the reason for these problems with social interactions is repetitive behaviours. Sensory processing difficulties also hurts social interactions (Gaines et al., 2016, p.29).

Most children on the spectrum experience sensory and motor problems at some point in their development. This includes under- or over-reactions to basic sensations and perceptions like touch, taste, sight, hearing and smell. There is an uneven variation of difficulties in every child (MoH&E, 2016, p.106).

2.2 Autism theories

Three cognitive theories dominate psychological research into autism.

The **Theory of Executive Function**

describes the control of cognitive processes such as attention, concentration, and planning. Many individuals with autism are understood to lack certain executive functions, causing problems with switching between different tasks, impulse control, organising thoughts or actions, and inappropriate behaviour. This impairment explains the source of repetitive behaviours (Gaines et al., 2016, p.41).

The **Theory of Mind** describes the ability to recognise others' mental state and interpret beliefs, desires, intentions, imagination, and emotions. Without this ability, an individual may have problems reading and relating to others. People with autism that lack this ability do not comprehend other people having different thoughts of their own. The behaviour of others may also be portrayed as confusing and unpredictable. Having 'mind-blindness' means all verbal messages are taken literally, which demonstrates why individuals on the spectrum often treat people like inanimate "objects". This theory is believed to explain some of the difficulties people with autism have with social interaction (Gaines et al., 2016, p.42).

The **Weak Central Coherence Theory** describes the inability to combine details into a meaningful whole. This is one of the theories used to explain an autistic individual's exceptional attention to details, which is a common trait. They fail to see the big picture but instead focus on small parts. This explains how individuals with autism often focus on irrelevant details and cannot think about ideas cohesively. This theory can also be used to justify some of the social difficulties associated with autism, like not being able to interpret emotions. Having exceptional attention to detail may also explain the distress caused to people with autism over changes in the environment (Gaines et al., 2016, p.42).

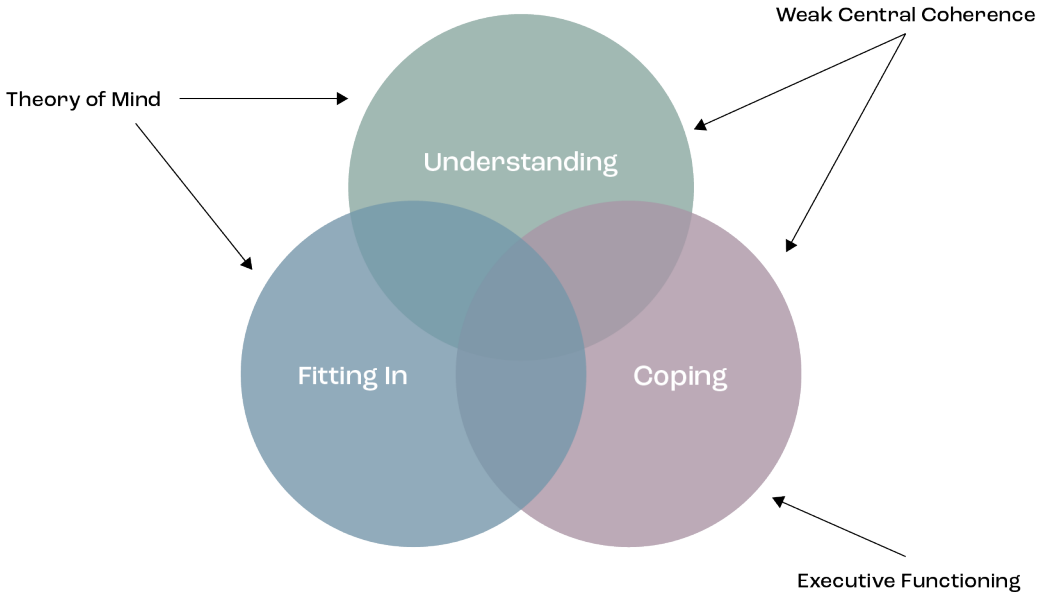


Figure 3. Autism theories relationship

2.3 Learning environments in NZ

Most children on the autism spectrum in NZ attend mainstream schools (MoE, 2015b, p.6); therefore, it is worth understanding the current state of educational buildings.

The Ministry of Education (MoE) is responsible for a portfolio of approximately 2,100 schools and 30,000 buildings in NZ (MoE, 2015b, p.3). Although these school buildings' age ranges up to 100 years old, they can be categorised into two groups: traditional and modern.

Traditional school buildings in NZ were constructed in the 20th century when the vast majority of school buildings were erected (MoE, 2015a, p.5). These were typically built off standard classroom block designs consisting of several single-cell classrooms, typically arranged in a line. Several blocks would make up all the learning spaces in a school (D. Brunsdon et al,. 2014, p.4).

Most schools in the country were built between the 1950s and 1970s when education was based on a teacher-centred system and structured classroom lessons. 70% of school buildings in NZ are between 30 and 100 years old (MoE, 2011, p.13).

Presently, modern school buildings in NZ are architect-designed in collaboration with Ministry staff; therefore, each school has an individual design. The MoE recommends that contemporary learning spaces be flexible, sustainable, creative, supportive, and connected (MoE, 2015b, p.34–35).

There has been a shift in school design in the past 20 years towards large learning spaces, prompted by curriculum and teaching philosophy changes. "Many schools are choosing to create large learning spaces because they support a range of teaching methods and allow team teaching of many students in one space. Students can also make use of a variety of learning areas inside the space and find the ones that work best for them" (MoE, 2020b, p.10).

The Ministry has adopted several concepts to describe learning environments in NZ. The term 'innovative learning environment' (ILE) refers to "the wider ecosystem of people (social), practice (pedagogical) and physical/property". Quality learning environments only refers to physical environments (MoE, 2021).

While most NZ school designs are traditional, they are slowly being replaced by quality learning environments as part of the Ministry's plans to modernise teaching spaces.

2.4 Education for special learning needs in NZ

Under the Education Act 1989, every child from the age of five has the right to attend their local school, which applies equally to children with learning support needs like autism. The NZ Disability Strategy and the United Nations Convention on the Rights of Persons with Disabilities also state that children with learning support needs have the same right to go to school like all other children.

In NZ, most children with special learning needs attend mainstream schools and may have additional school help. It is the school's responsibility to ensure that children have a safe physical and emotional environment. If changes to buildings are necessary, the MoE should be approached for support.

If a child has high needs, they may be able to access one of 28 special day schools in NZ.

Figure 4. Traditional school environment

Figure 5. Modern learning environment

Residential schools and health schools are other options for children with unique needs.

Some special schools operate satellite classes on the premises of mainstream schools for children with high needs and some may have units that provide specialist support. The children move between regular classes and the unit (MoE, 2010, p.6).

2.5 NZ autism guidelines

While there are no specific guidelines on autism-friendly learning environments for designers in NZ, there is some limited information available for educators of pupils on the autism spectrum. There are also school design guidelines that designers must abide by.

The '**New Zealand Autism Spectrum Disorder Guideline**' contains information from the Ministry of Health (MoH) for people that work alongside autistic children and adults. Part of this document pertains to the education of learners on the autism spectrum.

Due to the diversity of autistic students, a wide range of support and intervention is required. Alongside teaching strategies, adjusting the learning environment can help support students.

Best practice for learners on the spectrum is achieved by teaching in an inclusive environment with other children, not in isolation (MoH&E, 2016, p.16).

Typical learning environments can be problematic. Children with auditory processing problems such as autism can be severely impacted by excessive noise causing distraction from learning tasks and impaired communication. Children who experience difficulties with over-stimulation to sensory information will need to have their learning environment adjusted. Teachers can make minor modifications to their classroom to address such issues. Successful interventions can lead to positive outcomes such as increased participation in study activity (MoH&E, 2016, p.109).

Spaces without sound-dampening such as school halls, corridors, technology, and science classrooms are typically noisy spaces, often producing an echo. Students with sensitivity to noise may need to move between quiet and noisy environments throughout the school day to provide some relief from busy settings. Children who are extra- sensitive to noise, may have to avoid loud areas or reduce the time spent to a minimum (MoH&E, 2016, p.109). The provision of quiet space is also important for most autistic children (MoH&E, 2016, p.119). Poor artificial lights or harsh sunlight can cause stress and distraction for some autistic children. Moving the child to an adequately lit area and providing them with a shaded play area are available options (MoH&E, 2016, p.109).

Reducing clutter and clearly defining space inside a classroom can help provide better learning conditions for students. In a regular classroom, a pupil on the spectrum could be provided with an individual workstation positioned away from the centre of the classroom to accommodate the needs for a structured, low-arousal environment (MoH&E, 2016, p.110).

Outside the classroom, interventions include visually marking play areas safe to access and using stop signs to prompt children to stop and wait at the school's exit points (MoH&E, 2016, p.110).

Behaviour problems in autistic children are challenging and stressful for educators

(MoH&E, 2016, p.116). This might involve a child not complying with instructions, disrupting classroom activities, having tantrums, destroying property and being aggressive towards themselves or others. These kinds of behaviour put the child at risk of being excluded from learning activities.

Behavioural interventions, such as modifying environmental triggers, focus on understanding the function of the child's behaviour and providing an acceptable alternative (MoH&E, 2016, p.117).

Overall, these adjustments generally involve relocating pupils to areas with different stimuli, depending on their needs. Such examples do not include improving the built environment itself but instead working around inadequate conditions.

These guidelines are targeted towards teachers but give architects insight into how educational building design affects some of its users. Architects also can improve some of the problems addressed here, e.g. poor lighting, noisy spaces.

'**Autism Spectrum Disorder (ASD): A resource for educators**' provides awareness about the condition and how it may affect their learning. Problems that autistic students may face in the learning environment are paired with practical solutions that teachers can use. Sensory difficulties and social interactions are two areas where the built environment can help or hinder the behaviour of students on the autism spectrum.

Most children on the spectrum experience sensory difficulties at some point during their development. Teachers can support these difficulties by adapting the classroom environment to be conducive to learning. It is essential for students to feel safe, calm, organised and ready to focus.

Students should be positioned in an area of the classroom that suits their sensory needs. Placing their workspace at the end of a worktable or slightly away from other desks may work well depending on the student's needs.

A quiet space can be set up for students who need an area to calm down and feel more settled. This space should include a favourite object or book to help the student feel calm.

When the classroom becomes noisy, the student should be moved away to a quieter space (MoE, 2016, p.13–14).

Children on the autism spectrum have difficulty with social interactions, so providing them access to social spaces and spaces to have a break can help (MoE, 2016, p.25).

This advice suggests that quiet spaces should be incorporated into the classroom. This may not be easily achievable, depending on the design of the classroom. The position of the pupil to sensory stimuli is another important strategy to help with concentrate and minimise distraction.

2.6 International guidelines

Other countries have developed school design guidelines that address the needs of students on the autism spectrum. One such document is '**Designing for disabled children and children with special educational needs**', which contains guidance for mainstream and special schools in the UK. It is aimed at education advisers, architects, and designers. Sections include the design approach, designing school spaces, detail development and case studies.

Designers should consider the varying impact a school's physical environment has on students' sensory experience. The built environment should have reduced levels of stimuli to provide a calming experience for learning. This means preventing sensory overload for children on the autism spectrum (DCSF, 2008, p.25). Acoustics and lighting have been highlighted as essential design considerations for students on the spectrum.

Appropriate levels of glare-free controllable lighting in the classroom should be included (DCSF, 2008, p.25). Light fittings should be low glare and not produce flickering or unwanted noise. Indirect lighting is best for autistic students (DCSF, 2008, p.199). The school environment should have high-quality acoustics and no sudden nor background noise (DCSF, 2008, p.25). Sound insulation between rooms and from outside enables conducive learning. Some autistic children find a room with long reverberation times and acoustically highly reflective surfaces distressing (DCSF, 2008, p.149).

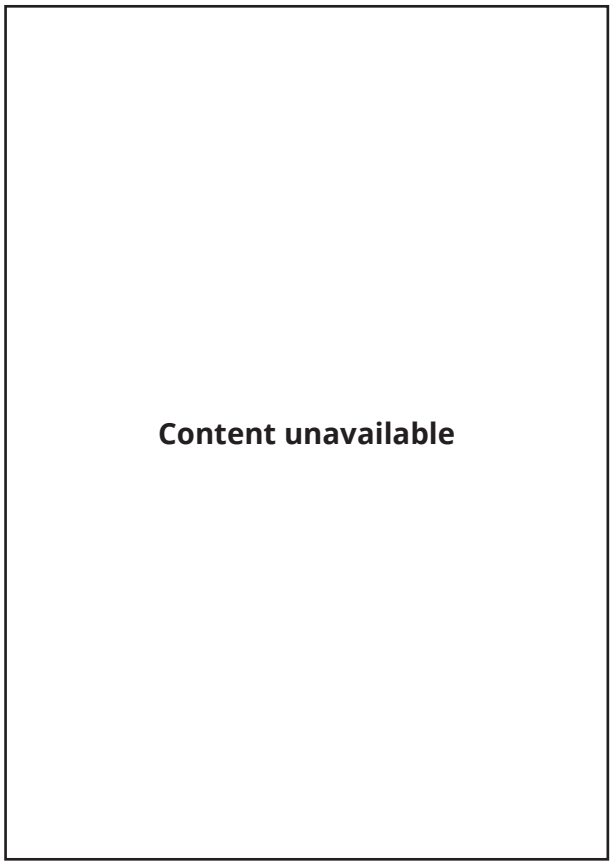


Figure 6. 'Designing for disabled children and children with special educational needs' cover

Visual contrast and texture can be utilised in sensory wayfinding (DCSF, 2008, p.25). Students on the autism spectrum value convenient travel routes and distances within the school (DCSF, 2008, p.38).
A learning environment for pupils on the autism spectrum should have a simple layout. Spaces should be calm, ordered and low stimulus while confusing large rooms should be avoided. Subdued colours are recommended for interior spaces. Robust materials, tamper-proof elements and concealed services may be necessary. Safe indoor and outdoor spaces should be included for students to withdraw and calm down. A quiet place in the classroom should also be included for them. (DCSF, 2008, p.199).

This level of detailed advice about autism is missing in NZ design guidelines for schools.

2.7 Design research

Most research into the physical design of spaces for individuals with autism comes from international sources. The school designs and pedagogy will likely differ from NZ, but most recommendations should apply to any context.

Magda Mostafa has published several articles on design criteria for autism-friendly spaces. According to Mostafa, there is a lack of architectural guidelines for autism, despite the unique needs of these users of the built environment (Mostafa, 2008, p.189).

Two opposing positions on designing for autism have emerged in the architectural research field. The first is the 'neuro-typical' approach, which proposes that the autistic user should be placed in a typical, overstimulating environment. The intention is to help the user adapt and prepare for the real world and its associated stimulations (Mostafa, 2014, p.144). This approach has limitations, such as assuming that the user has the minimum amount of skills required to be adaptive and use such environments.

The second approach is the Sensory Design Theory, which involves making positive changes to the sensory environment of the autistic user. The aim is that it will lead to positive and constructive behaviour, especially in learning environments. Using this approach, various stimulus areas tailored to different activities and different skill levels of its users are supported. Unlike the 'neuro-typical' approach, the Sensory Design Theory has been empirically tested. Preliminary evidence from empirical testing has shown that the application of Sensory Design Theory improved the concentration and behaviour of autistic users (Mostafa, 2014, p.145).

Mostafa advocates for the Sensory Design Theory and argues that autistic behaviour can be positively influenced by modifying the sensory environment. (Mostafa, 2014, p.145).

The 'greenhouse effect', where a student becomes dependent on spatial supports for the entirety of their education, should be avoided. Instead, the classroom environment should gradually progress from an ideal setting at the early stages of development to a neuro-typical space at the later stages (Mostafa, 2018, p.321–22). This way, the student is provided with the tools to develop their communication, interaction, and learning skills and, over time, function in a typical environment.

Keith McAllister is another prolific researcher of autism-friendly design. McAllister argues that sheltering autistic students from distractions will not necessarily help them reach their full potential in life. Instead, pupils should be taught to manage change and external factors within their surroundings (Mcallister, 2010, p.3). By doing this, students on the spectrum are more likely to cope in mainstream education and society in general (Mcallister, 2010, p.4).

Mcallister also acknowledges that there are a lack of design guidelines specific to children with autism (Mcallister, 2010, p.2).

2.8 Comparison

A comparison table was produced, comparing the recommendations from the different literature sources.

This table shows that quiet spaces and spatial organisation are the most frequently mentioned and essential considerations for autism-friendly spaces. Having a dedicated quiet or 'escape' space for students to retreat to and clearly defining the different functional/ sensory areas of a learning environment with clear visual boundaries are deemed necessary across the literature reviewed.

Acoustics and lighting are the next most important aspects of the learning environment showing that environmental factors and student wellbeing are highly regarded.

There were different target audiences across the literature reviewed (educators and designers/ architects) whom each have separate control of a learning environment's design. Therefore, the scope of recommendations were varied. For example, the guidelines aimed at teachers recommended that students be positioned away from inadequate artificial lights or harsh sunlight. In contrast, the guidelines for architects recommended incorporating controlled lighting in the first place. Regardless, this still highlights the importance of illumination regarding student behaviour and learning.

The literature findings were primarily based on feedback from professionals or caregivers (teachers and parents), rather than the students themselves. While these opinions are beneficial, it means that the group who were the focus of these studies has been given limited opportunity to comment on their physical environment, and influence design recommendations.

	Acoustics/ noise	Spatial sequencing	Quiet/ escape space	Space organisation	Transition areas	Sensory grouping	Safety/ security
Autism Spectrum Disorder Guideline			✓	✓	✓		
Autism Spectrum Disorder (ASD): A resource for educators'			✓				
Designing for disabled children and children with special educational needs	✓		✓	✓			✓
Mostafa 2008, 2014, 2018	✓	✓	✓	✓	✓	✓	✓
Altenmüller-Lewis 2017	✓	✓	✓	✓		✓	✓
Mcallister 2010, 2012, 2016	✓		✓	✓	✓	✓	✓

Table 1. Comparison table of different guidelines/ research vs recommendations

2.9 Positives and negative influences

In addition to design recommendations, the literature sources were also reviewed for information about positive and negative influences of a school's physical environment on the learning of autistic students. A summary of the findings is provided in Appendix 1.

2.10 Conclusion

The literature review was useful in obtaining design recommendations. The research shows that a learning environment can either disadvantage or benefit autistic students. If modified effectively, they can improve students' behaviour and education. A learning space's sensory qualities were highlighted as having a significant impact on students, which correlates with the sensory impairments this group experienced.

The literature revealed a lack of recommendations in NZ school design guidelines on accommodating autistic students. Whilst design guidelines for architects mention accommodating all students, there are no specific recommendations for making typical learning environments autism-friendly. Advice for helping students on the autism spectrum is available to educators, but they have limited control over their teaching space's physical design.

There was also a lack of research into the design of mainstream classrooms accommodating autistic students. Studies tended to focus on learning environments solely for autistic children. While these reports' design recommendations were useful, they might be challenging to translate to a mainstream learning environment that contains more students and more working spaces.

Lighting/ daylight	Colour	View	Furnishings/ storage	Group size	Playground	Circulation/ wayfinding	Workspace/ positioning	Inclusive	Reduce clutter
						✓	✓	✓	✓
							✓		✓
✓	✓		✓		✓	✓			
✓	✓					✓			
✓		✓	✓	✓	✓	✓			

There were conflicting views on designing for autism, demonstrated by the opposing positions of the 'neuro-typical approach' and the Sensory Design Theory. This makes it difficult to propose a definite approach to designing an autism-friendly classroom. The position of this research is that some level of intervention in the learning environment is necessary to aid students on the spectrum, but not overly tailored that it leaves students unprepared to cope in other environments.

This review has also highlighted the vast diversity of sensory needs among children on the spectrum, and whilst a space designed for autism will not be able to address all these needs, it can at least attempt to cover the broad needs shared by this group.

Case Studies

3

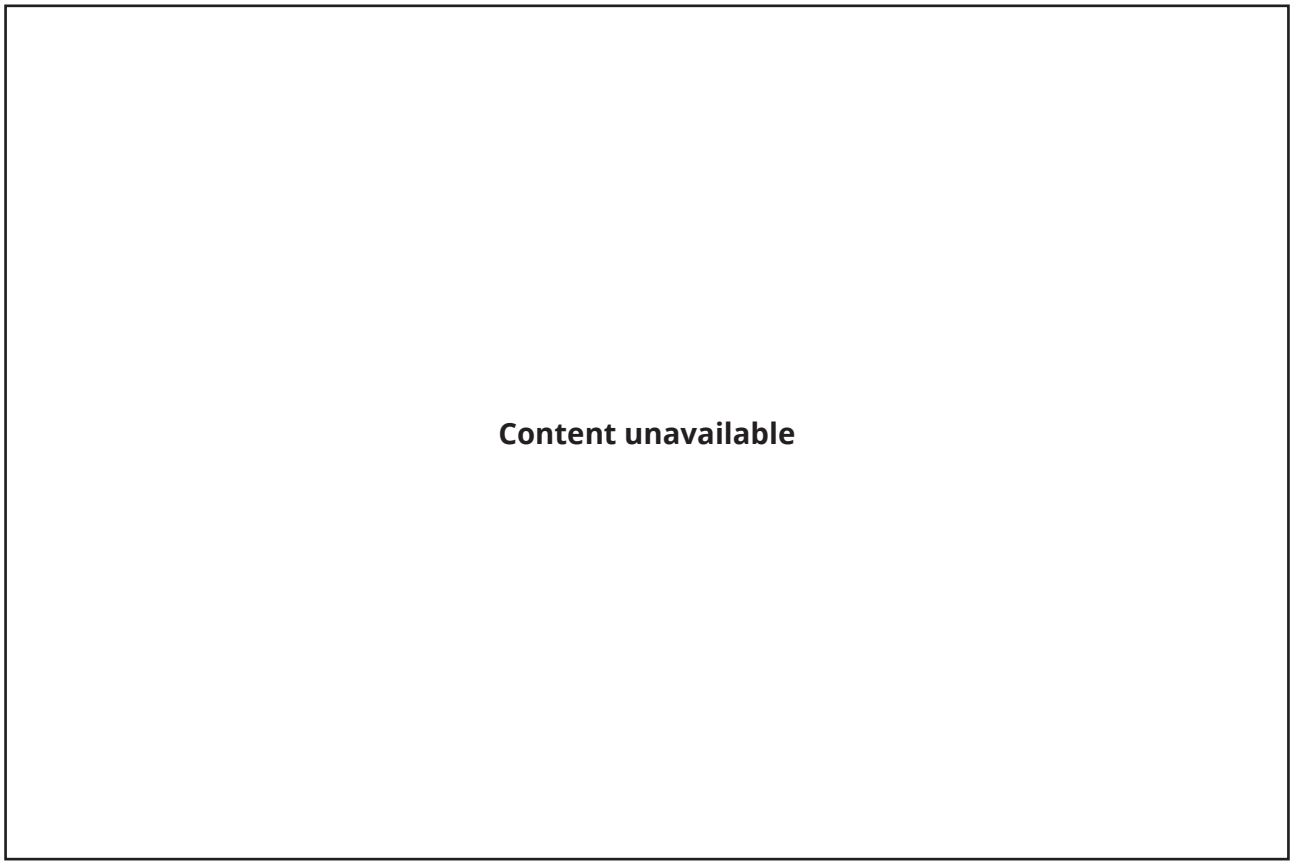
3.1 Northern School for Autism

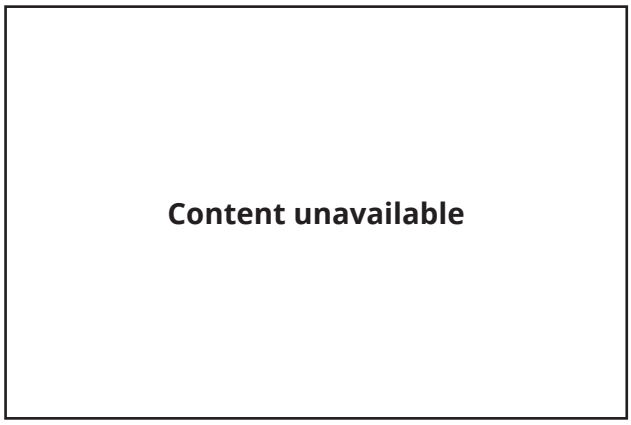
The Northern School for Autism, designed by Hede Architects, is a school design in Melbourne, Australia, catered to students with autism. The project aimed to produce a building that would support the pupils in self-regulating and managing their behaviour (LEA, 2013).

The school has been designed to be calm and inviting for students. Paul Hede explains that designing for students with autism is often "about reduction of stimulation, but not all students are served well by that". To accommodate both hyper-sensitive and hypo-sensitive sensory needs, the design for the school offers students choices. "The building is broken down, ultimately, into little spaces that those children feel happy in and can control" (Bozikovic, 2017).

Lighting and colour have been adapted to suit the needs of students with sensitivities. Natural light within the classrooms is plentiful, which minimises any reliance on fluorescent lamps. Earthy, natural tones are used throughout the school to accommodate sensitivity to colour. The classrooms have been designed for small groups of 6-8 students (LEA 2013). Each teaching spaces includes a semi-enclosed withdrawal space, an outdoor courtyard and access to the outdoor play area. The outdoor courtyards provide a space for students to both calm down and move actively (Bozikovic, 2017). Alongside the learning spaces is a therapy wing containing speech, occupational, music and play therapy rooms (LEA, 2013). The corridors are rounded, with no blind corners or obstructions to allow students to move freely and run through the space (Bozikovic, 2017).

The sensory-friendly design features like natural light and muted colours are more easily applicable to a mainstream context than others in this project. The classrooms are too small for a mainstream school, meaning students on the spectrum would be surrounded by more people. The lack of colour, decoration and views to the outside might be under- stimulating to some autistic and non-autistic students.





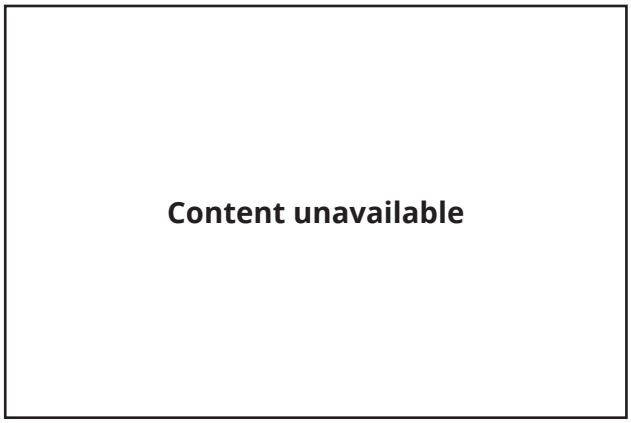


Figure 7. Northern School for Autism

3.2 Pears National Centre for Autism

The Pears National Centre for Autism is located in North London (Ambitious about Autism, n.d.). The purpose-built centre was intended to balance calm and stimulating. Completed in 2008, the design accommodates an 80-place school for 3-19-year-olds.

The teaching spaces are simple, flexible, and repetitive. Small workrooms and life skills environments, like the kitchen, bathroom, and laundry, are included. Opportunities for learning potential have also been designed in the back of house areas such as delivery or maintenance (Penoyre & Prasad, n.d.).

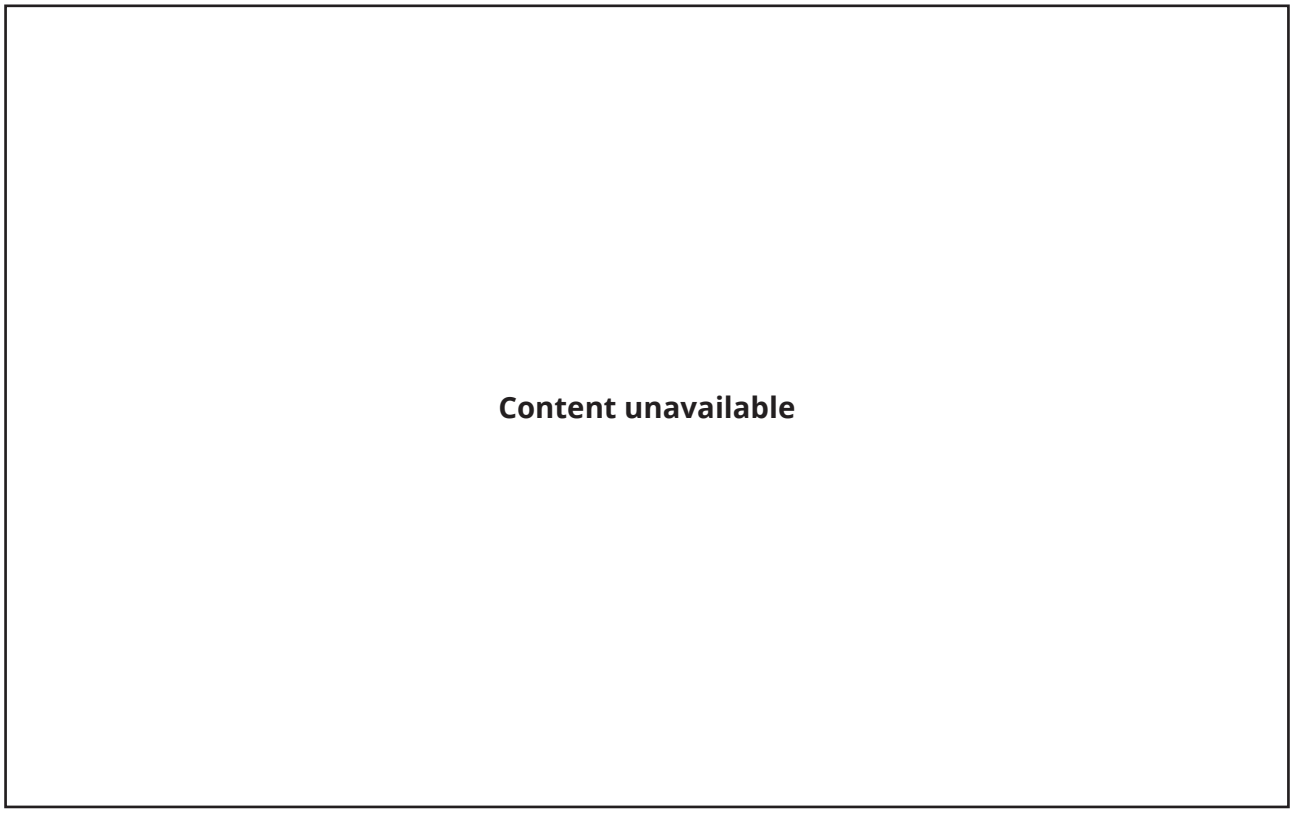
Pupils have access to quiet rooms if feeling stressed. The circulation spaces and break out areas are large and open to allow for low-density environments. The spacious gym and music rooms are ideal settings for expression and destressing (World Architecture News. 2011).

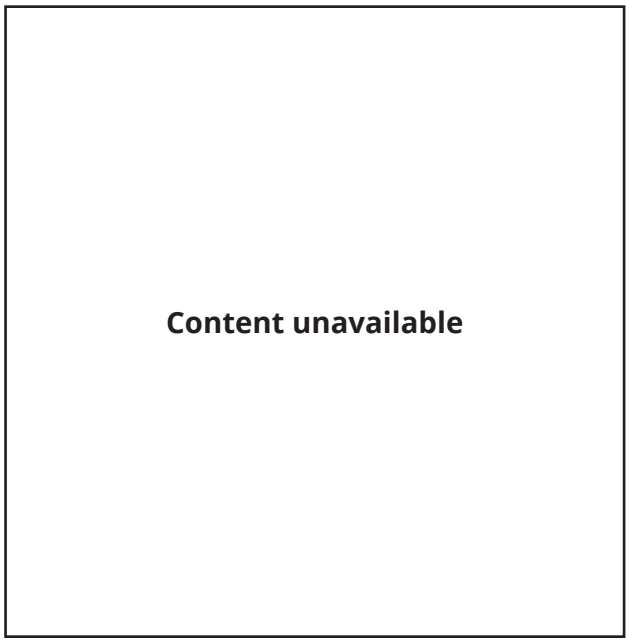
High levels of natural light are spread evenly throughout the building, and the temperatures are constant (World Architecture News, 2011). The building utilises natural daylighting, a high thermal mass, and an assisted natural ventilation system (Penoyre & Prasad, n.d.).

Externally, a variety of external spaces for learning and play have been included. Sustainability was a big focus of the project, integrating natural materials and sustainable technologies such as a living green roof and underground ventilation (Ambitious about Autism, n.d.) (Penoyre & Prasad, n.d.).

This balance between calm and stimulating and the sustainability features would be beneficial to include in this research. This design's vast number of amenities is exceptional and would be good to see in a typical learning environment.

This project does cater to the same age group as primary school students in NZ; however, it also has a broader range of users, aged from 3 to 19 years old. This means not all programmes in this project would be appropriate for the primary school level. The design is also based in the UK, which has a different curriculum and education system to NZ. This project is also specifically for students with autism, which is not a mainstream environment. It has been designed for a small group of students, whereas typical primary schools have a much larger student population. A busier environment with more users in each space must be expected in a mainstream school putting extra stress on students on the spectrum. A mainstream school may not have space or resources to provide a spacious environment or the life skill environments like in the Pears National Centre for Autism.





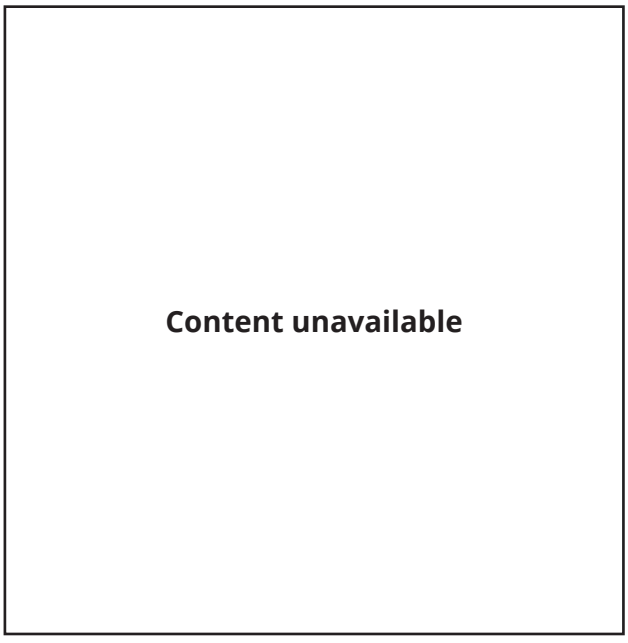


Figure 8. Pears National Centre for Autism

3.3 Autism NZ Resource Centre

Designed by Bonnifait + Giesen Architects, the National and Regional Resource Centre for Autism NZ provides a comfortable environment for the autism community and their families. Both Autism NZ staff and external consultants are housed together to enable collaboration (Bonnifait + Giesen Architects, 2021). The facility offers essential services to families and individuals with autism (RNZ, 2020).

The building has been purposefully designed with the needs of autistic people in mind. The lighting, colours, textures and furniture have been carefully selected to accommodate any kind of sensory issue experienced by those with autism (RNZ, 2020). A central path extending through the building allows users to navigate the building independently. Every space is naturally lit, defined by clear boundaries, and offers a unique sensory experience. Children visiting the centre can choose between the low sensory 'Playroom Nook' or the more stimulating 'Expression room'. A series of mobile booths provided throughout the building gives users the option to hideaway when desired for reading, online activities and general quiet time (Bonnifait + Giesen Architects, 2021).

This modest precedent offers design features that could be useful to investigate in this research. Although this is not an educational space, this precedent does present some unique areas for individuals on the autism spectrum that could be of relevance to this research. This precedent is also notable for being a rare building type in NZ. Having opened in 2020, the research and decision-making behind the design of this project should be current.

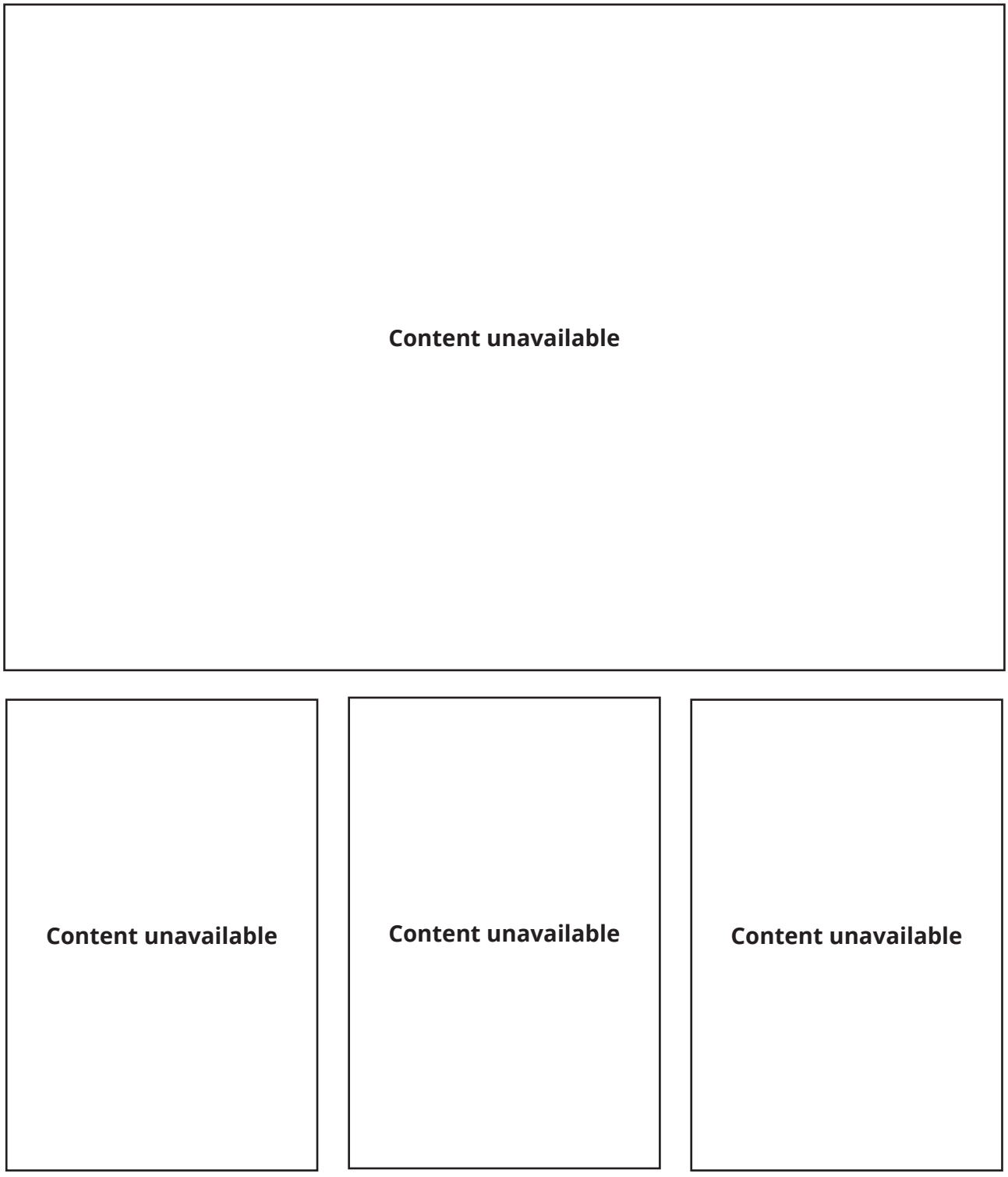


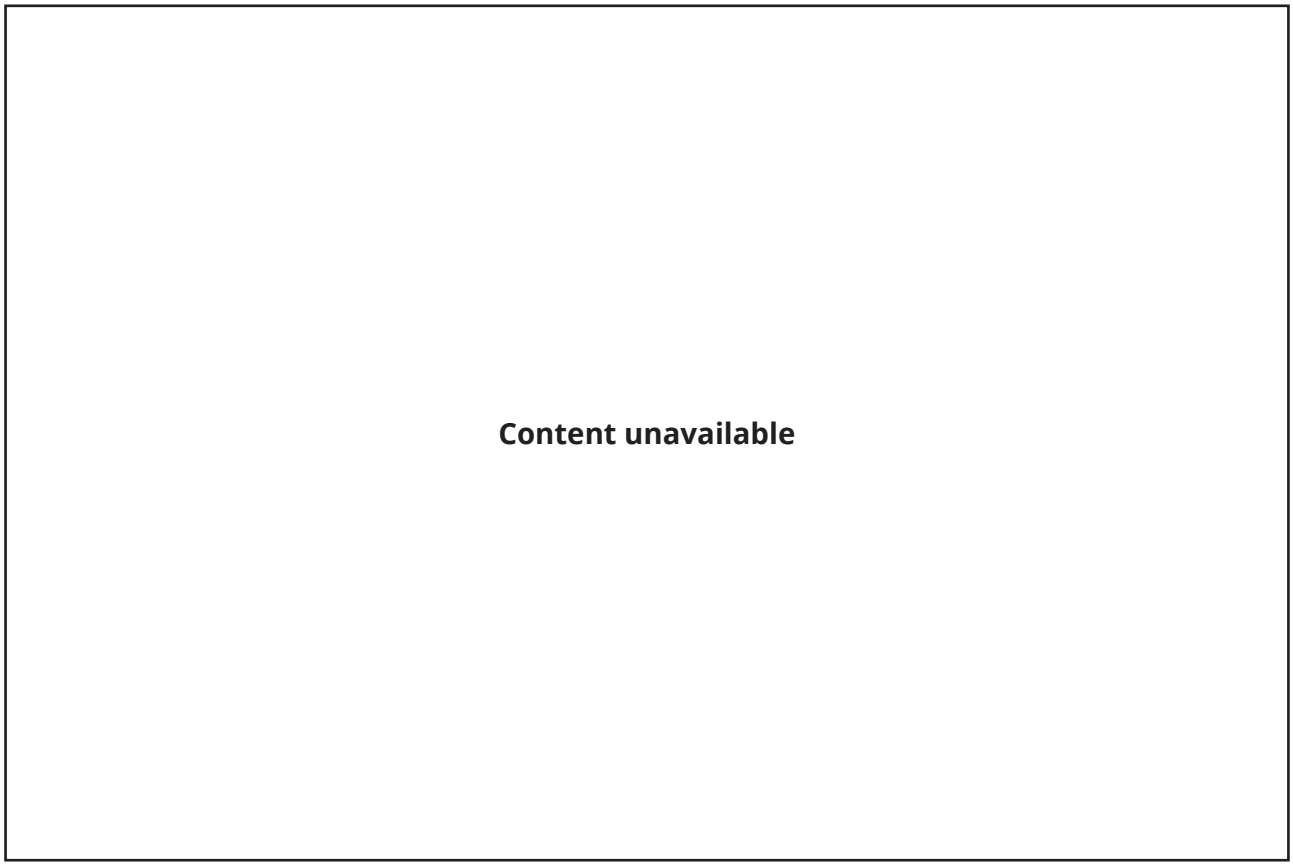
Figure 9. Autism NZ Resource Centre

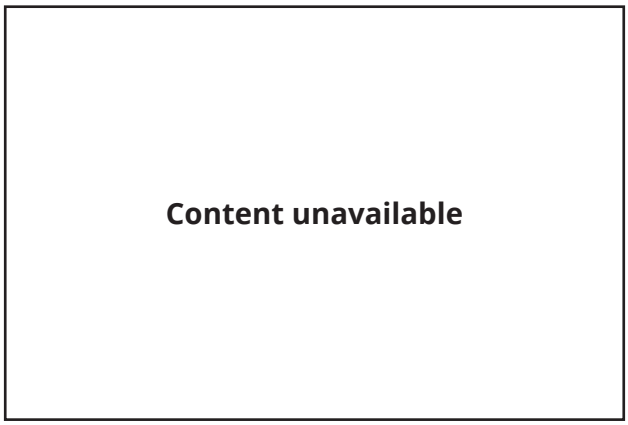
3.4 Freemans Bay Primary School

Freemans Bay Primary School is an example of an innovative learning environment in NZ. RTA Studio was commissioned to design several new school buildings and, in the process, create a new exemplar in modern learning that was forward-looking.

Among the recent additions to the school is a new two-storeyed classroom block. 80-90 students work within the open-plan space, which contains a variety of learning areas. Flexible teaching spaces can accommodate a variety of pedagogical practices and different subjects (RTA Studio, n.d.). The building includes a range of amenities, many that are multi- purpose. The main open-plan space is designed for medium-to-large group learning, while the small enclosed break- out rooms on the periphery serve as quiet study areas. The stairs also function as a workspace. Wet areas, kitchens, making spaces, a large slide and retreat areas are also included. Furniture is minimal to allow the learning environment to be adaptive to different activities (Barrie, 2020).

This design may pose some challenges to children with sensory issues. The open-plan design may be too noisy for some children to concentrate. Visual information in this environment, like the bright colours, may become overstimulating. The lack of furniture may prohibit students from having a permanent workspace suited to their sensory needs. The quiet rooms and cave areas may be appropriate to work inside if there is no sound penetration from the other spaces. Enclosing the break out spaces clearly defines them from the open plan learning space, helping students differentiate the spaces. The flexibility of the open-plan spaces mean the different areas within are not as clearly defined.





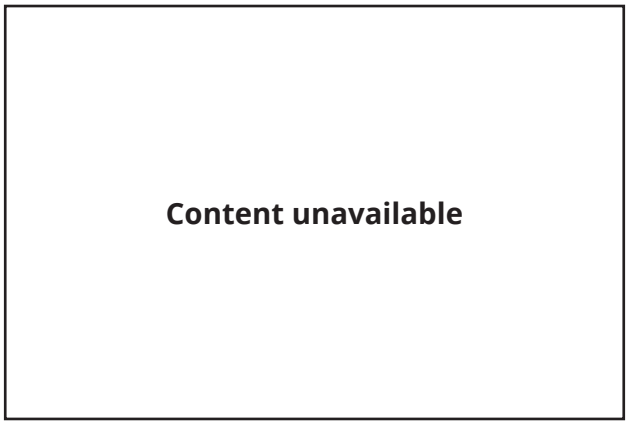


Figure 10. Freemans Bay Primary School

3.5 Conclusion

The schools for pupils on the spectrum are successful in accommodating the broad requirements for the pupils. Careful thought has gone into creating an environment tailored to the sensory needs of this group. There are also examples of the buildings generalising skills and helping students to adjust to typical environments. The drawbacks are that these are spaces explicitly designed for students with autism and do not have to accommodate a larger mainstream population. These are small scale, and the benefits gained might be lost when applied to a larger scale. The spaces are rigid and purpose-built, which conflicts with the flexibility of modern primary schools.

Innovative learning environments accommodate many students, which does not work well for students on the spectrum. Colour palettes of bright colours used in these spaces may also not be suitable for students with hyper-sensitive needs. The larger open plan spaces could be problematic for acoustics and spatial organisation and the high volume of users. The break out spaces are more successful when they are clearly defined, have a singular function, and acoustically separated from the surrounding area. Quiet break out rooms could be beneficial for students with autism, although it is unknown how these pupils cope when sharing the space with other students. Autistic students would benefit from having their own escape space.

Classroom surveys

4

4.1 Introduction

Two school visits were organised to gather primary data on both a traditional and a modern/innovative learning environment and establish what mainstream learning environments look like. This information could reveal potential conflicts with students on the spectrum and inform possible solutions.

Parameters/ design features to record whilst visiting the schools were taken from the literature review design recommendations. McAllister's survey checklist in '**The ASD Friendly Classroom – Design Complexity, Challenge and Characteristics**' was also used to check specific elements.

McAllister's factors included classroom layout, finishes, windows, view, noise, light, senses, furnishings, and external elements. Photography, drawings, and notes were sufficient to record most physical features. Variable factors were hard to register and could not be generalised to give a typical result. Because the classrooms were empty during the visits, information such as normal noise levels and space use was unfeasible to document. The learning environments were visited after school hours, so the sunlight and daylight levels differed compared to regular school hours when in use. Background noise might also vary during the day.

The school visits were also conducted during Alert Level 2 of COVID-19, and while most students were back at school, some areas of the schools were closed off and unable to be visited.

4.2 Thorndon School

On Thursday 21st May 2020, a visit to Thorndon School was conducted. Photographs and videos of classrooms were taken of each learning space.

The school design consists of 4 large learning studios, each containing the main learning space, a wet area for painting or cooking, and several break-out spaces for quiet study activities. Each studio has a different furniture setup and also has access to its own outdoor learning space.

The main learning spaces were sizeable open plan areas and acted as the hub of the studios. The breakout rooms had single glass doors, allowing them to be enclosed from the main learning space. They all had an external view, and some of them had a large area of glazing, which allowed teachers in the main learning space to monitor students working inside them. The wet area was contained within the main learning space.

There was very minimal furniture in some studios, and the main teaching spaces were empty except for some tables and chairs. Other studios were primarily occupied by furniture. Because this visit was conducted outside of school hours, it is unknown how furniture was usually arranged in the classrooms. Furniture and storage units had a variety of bright and muted colours.

The functions in each breakout room varied across the studios. The junior studio had a reading room and small teaching space, while the breakout rooms in the other studios were used generally used for quiet study. The occupancy sizes of the breakout rooms also varied from small groups to whole-class teaching. The new entrants had their own space in a large breakout room. The sliding door into the room could be kept open for collaboration with the other year groups or closed for private learning.

The wet areas in each studio provided a large

open area for painting and making, sink space and an oven. The junior area had a larger wet area, presumably because they do more creative activities than the other year groups.
The colour palette inside the learning studios consisted of subdued colours in the main learning spaces and bold colours in the breakout spaces. Small blocks of bright colour appeared in the carpet, wall coverings and storage units in the main learning spaces.

A combination of finishes was used in the learning spaces. Plywood walls and acoustic panelling were used around the outside breakout spaces. The remainder of the wall surfaces in the main learning spaces consisted of a light grey wall covering the lower half of the walls and a white paint finish on the upper half. Dark grey carpet tiles with a subtle striped pattern were used for the flooring. The larger break-out rooms used the same materials and colours. A dark grey vinyl flooring was used for the wet areas.

The small-to-medium breakout spaces in each studio had a distinct colour, with the wall coverings and carpet tiles being coordinated. Some breakout spaces had natural colours like blue or green, while others had intense colours like orange and yellow.

The number of wall decorations and visual information in the breakout rooms and main learning spaces varied across the studios. There were large areas of blank wall surfaces in some spaces.

The ceilings in all the spaces consisted of white monolithic face acoustic ceiling tiles and flush fluorescent lighting. The ceilings were either slanted or flat, depending on whether there was another learning studio above. Two of the learning studios had clerestory windows at the tall end of the space.

The junior learning studio had the most extensive outdoor learning environment in the school. It consisted of an open courtyard with benches, tiered seating, a large chalkboard, and a mural bordering one side. Adjoined to the outdoor space was a corridor underneath two other learning studios, where bag storage was located. The end of the corridor was gated, presumably to prevent students from running away.

The school had some playground equipment, including a slide and a climbing structure. The school had a restricted site, so the field area was small. There was also a basketball court.

Figure 11. Thorndon School learning spaces

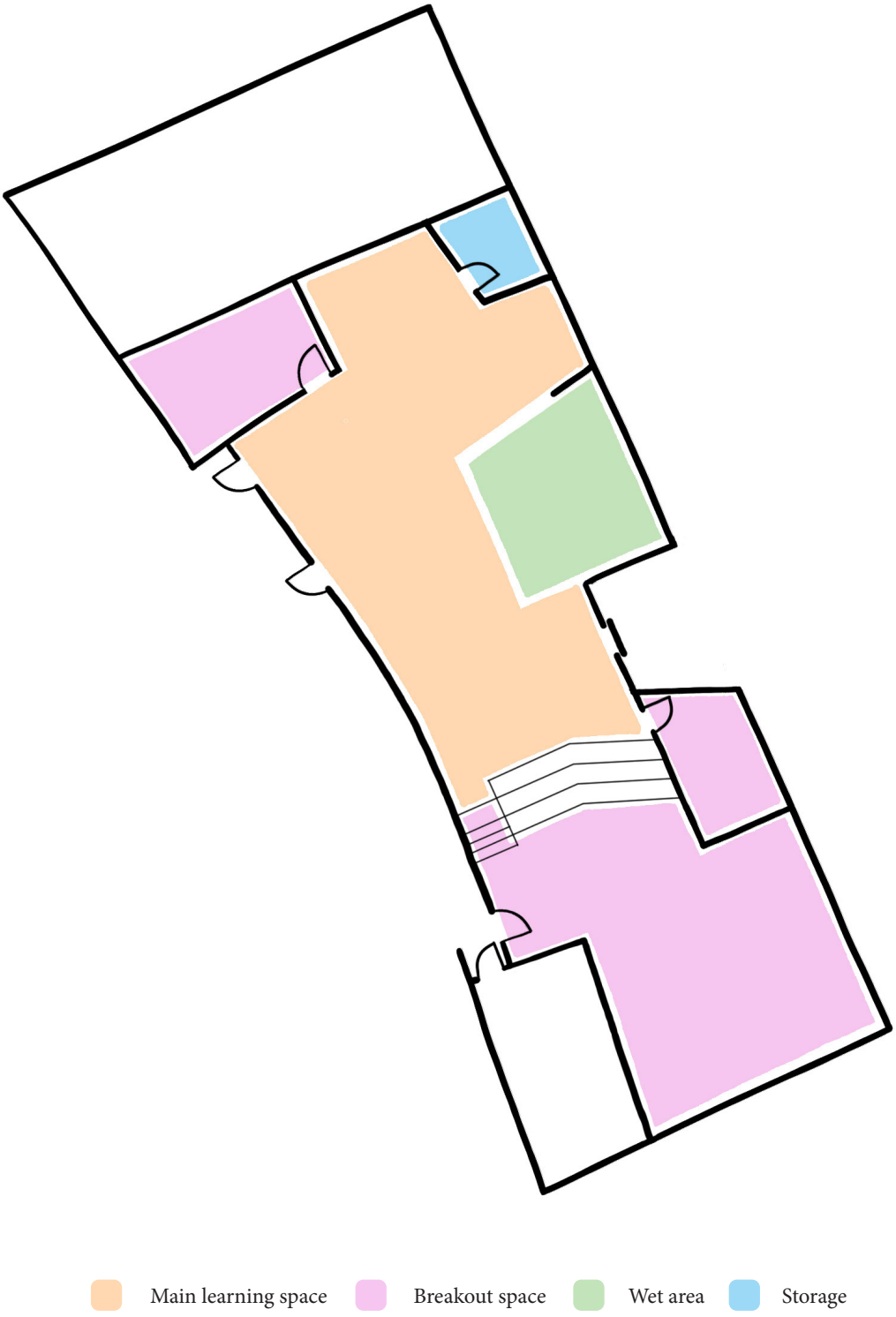


Figure 12. Thorndon School learning studio floor plan

4.3 Berhampore School

On Friday 22nd May 2020, a visit to Berhampore School was conducted. 6 classrooms and the school's outdoor spaces were visited after school hours.

The school has 12 single-cell classrooms overall. Most classrooms have a simple rectangular floor plan with sliding doors connecting to an adjacent classroom.

Each classroom had a different setup. The tables in the classrooms visited had 4-6 ergonomic chairs arranged around them.

Each classroom had a large whiteboard on a wall, some with a projector attached above. The classrooms also had a mat area where students sit and are instructed by the teacher. This is defined by a large space in one corner of the room. A mobile teaching station with a whiteboard display and a chair for the teacher is situated in this area. Curved ottomans, couches or beanbags were provided in some classrooms.

A range of open storage units for student workbooks, stationery and learning tools are spread around the classrooms. A mobile book display to store books was also provided. Bag storage was provided outside the classroom by the entrance.

Some classrooms have bright wall coverings, while others had neutral colours. All but one of the classrooms had plain grey carpet. The exception was the junior classroom which had grey patterned carpet. Most furniture, like chairs and tables, had muted colours. Some furnishings had bright colours like red or orange.

Some classrooms had a large number of wall decorations or hanging decorations suspended across the room. There were visual timetables and charts in some classrooms, which would help students on the spectrum learn visually.

Most of the classrooms visited have a vaulted ceiling, with skylights and a painted air duct. The ceiling area and roof framing in these rooms were painted white. Although skylights and windows are incorporated into each classroom, fluorescent lights provided additional lighting. The other classrooms had a flat ceiling with fluorescent lights.

One of the classrooms visited was a Montessori classroom. The room consisted of a very spacious open-plan space, a tiered seating area and a large wet area at the back. The tables and chairs were all timber. The overall colour scheme was very calm and muted, such as the pale blue wallcoverings, but some bright-coloured play equipment was in the classroom.

Some classrooms had a timber-made retreat cube that could fit one student at a time.

Each classroom has direct access to one of several external courtyard areas. This was also the only exterior view most classrooms had. These courtyards included amphitheatre seating, benches, picnic tables, trees, planter boxes and a small court for ball games. Play areas included a sandpit, monkey bars and a large playground.

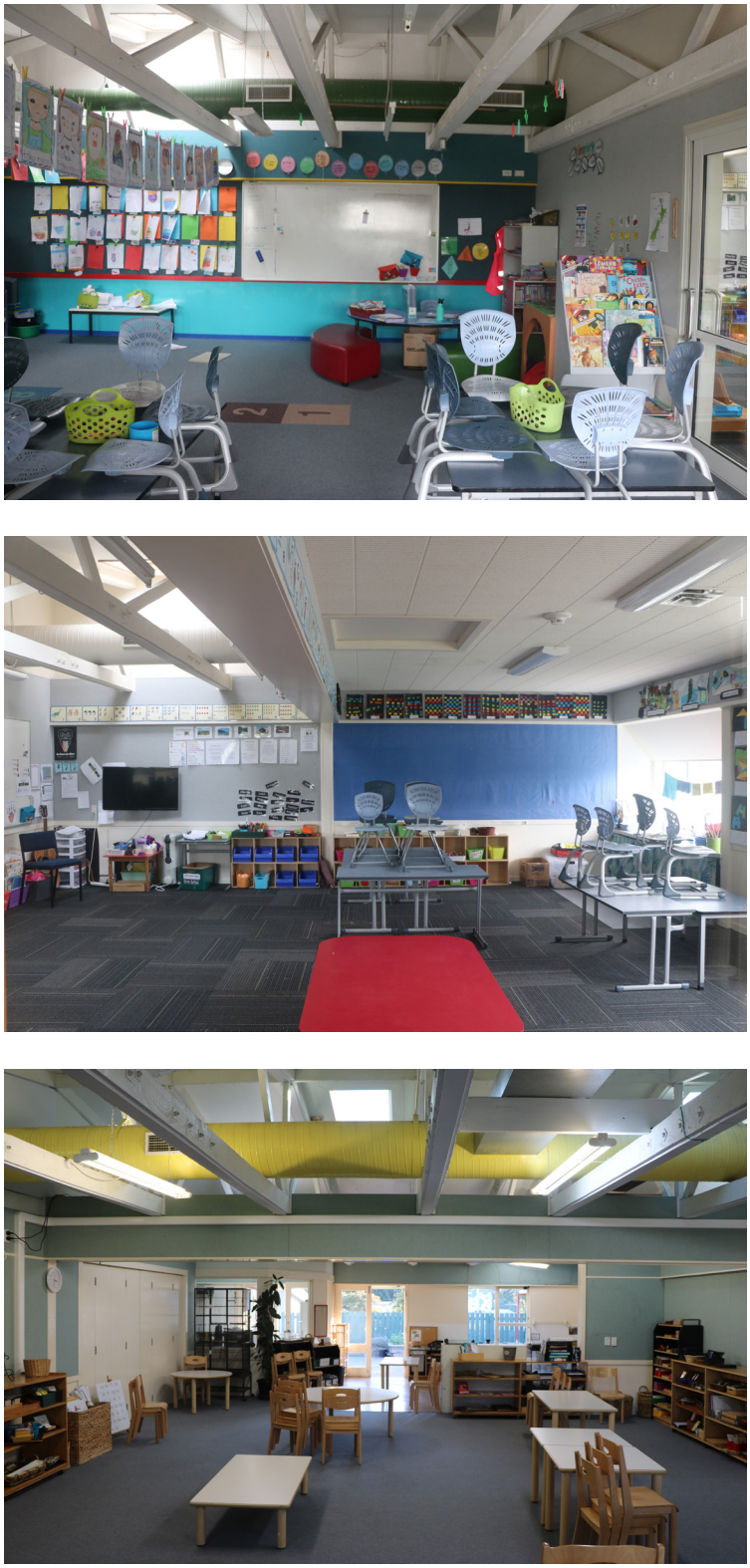


Figure 13. Berhampore School learning spaces

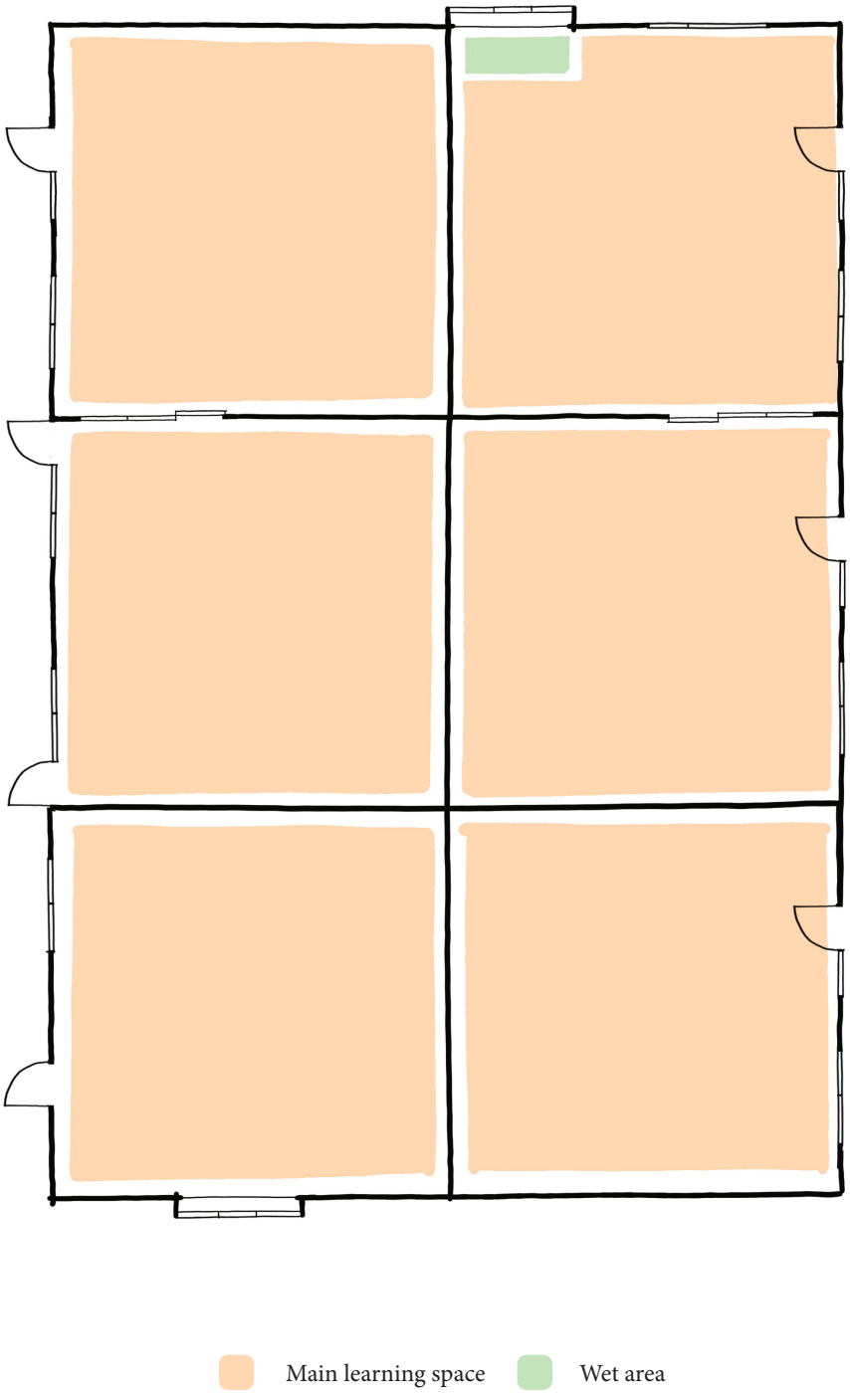


Figure 14. Berhampore School classroom block floor plan

4.4. Visual analysis

Visual analysis was undertaken on different learning spaces at both schools. The aim was to identify positive and negative physical features to the sensitivity of children on the autism spectrum, based on the findings from the literature review. Because autistic children have a variety of sensitivities, some features will not affect some students.

Thorndon School Assessment

While most of the learning spaces' colours would be suitable for students with hypersensitivity, some of the brighter colours could be triggering. Students on the autism spectrum might need to use the breakout rooms to escape the main learning spaces, so having bright colours inside would be unhelpful. Most furniture had a neutral colour, but some items could be too bright.

The large size of the main learning spaces and the high number of students inside would concern students who are sensitive to noise and busy areas. Thorndon School had the benefit of having modern soundproofing. There was some acoustic treatment provided through wall coverings, plywood panels and ceiling tiles.

Some spaces were highly decorated, which might be overwhelming to some students. This depends on the student; therefore, decorations might be tolerable in some situations.

A positive aspect of Thorndon School was the variety of spaces that students could access. The inclusion of quiet study rooms would be beneficial to students who find the main learning space disturbing. The outdoor learning areas would also provide some respite from loud indoor conditions. There was no dedicated area for students to retreat.

The enclosure of the breakout rooms makes the space clearly defined for students on the spectrum. The unique colour scheme in each space also helps them to differentiate between the spaces. The smaller breakout rooms would provide a comfortable experience for students.

The wet areas were clearly defined with different flooring. However, the main learning spaces lacked designated areas.

The exterior walls of the studios were not highly glazed, so opportunities for distraction were limited. The clerestory windows found in some studios would be advantageous for providing natural lighting without distracting students. The breakout rooms with large glazed walls could be distracting to students inside or outside. There was an extensive reliance on artificial lighting, but it did not produce any flickering.

Although the school had a climbing structure, the lack of playground equipment was noticeable.

Main learning space

Positives

1. Neutral/ natural colours
2. Natural lighting
3. Acoustic panelling

Negatives

1. Large workspace
2. Bright colours
3. Sightline to other workspace
4. External view
5. Artificial lighting

2. Medium breakout room

Positives

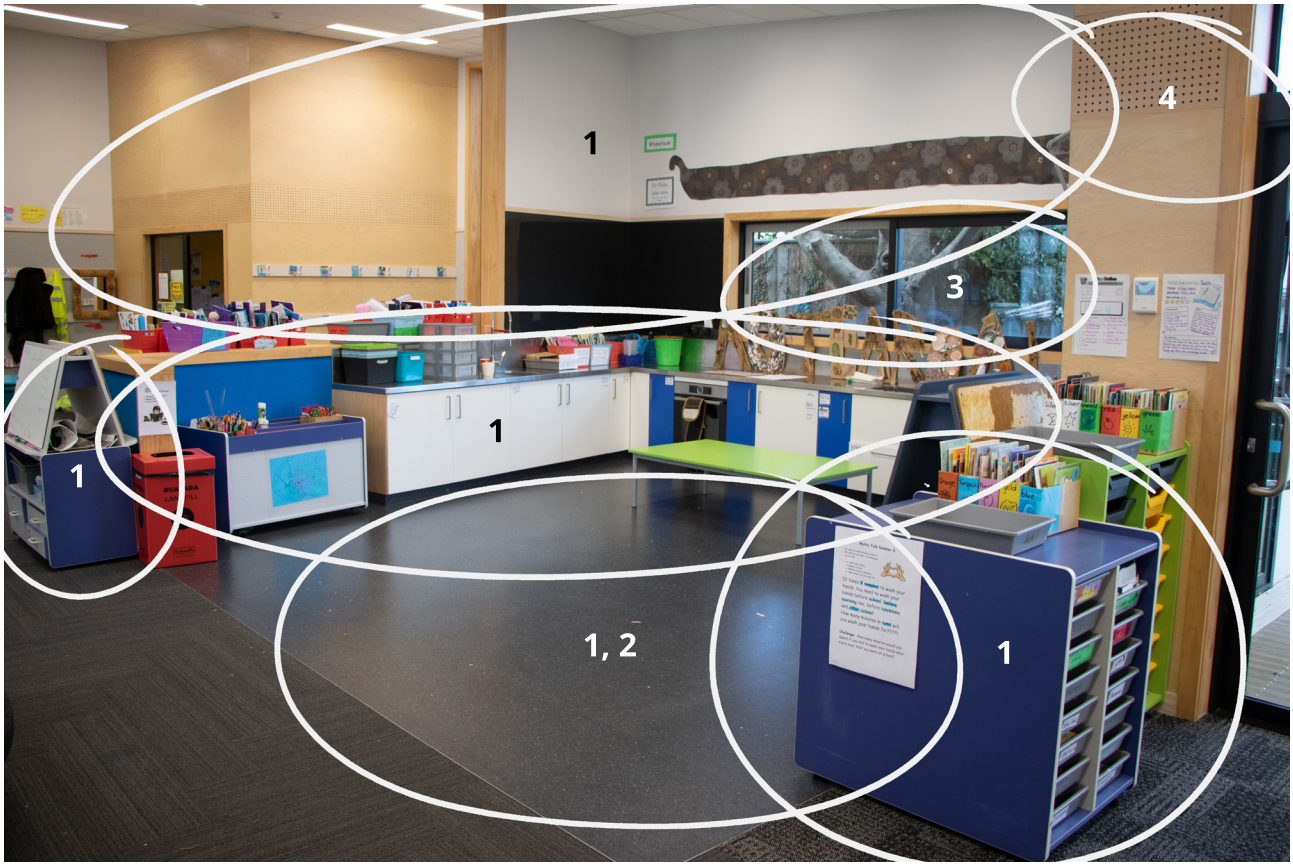
1. Small, enclosed work space
2. Visual contrast
3. Acoustic wall coverings
4. Comfortable loose furniture
5. Natural light
6. Neutral/ natural colours

Negatives

1. Bright colours
2. Disorderly decorations
3. External view

Wet area

Positives



1. Neutral/ natural colours
2. Defined area
3. Natural lighting
4. Acoustic panelling

Negatives

1. Bright colours
2. Clutter
3. External view
4. No curtains/ blinds

Berhampore School Assessment

Berhampore School had a variety of classroom designs. Some classrooms had a neutral colour palette, minimal decorations, and tidy storage areas, making the spaces feel calm. Other classrooms had bright colours, lots of decorations and cluttered areas, making the spaces feel overwhelming. Again, some students on the spectrum will not find this overstimulating, but others will.

The classrooms had a simple layout but lacked in variety of spaces. There were no quiet workspaces for students to move to. The vaulted ceilings made the rooms feel more spacious but might suffer from poor acoustics. The skylights provided daylight to the spaces but did not offer a clear connection to the outdoors.

Berhampore provided permanent workspaces for students on the spectrum who needed to work away from other students. The students at Thorndon School did not have a permanent setup but could still work on their own.

The retreat cubes were an innovative idea for students who needed to feel enclosed. This demonstrates that the school had a dedicated approach to helping students on the autism spectrum.

The Montessori classroom had the most significant number of strengths. The colour palette was vastly subdued and calm. The wooden furniture and storage provided a more natural colour palette. The extra floor area made the room feel spacious. The storage areas were tidy and organised. There were very few decorations to distract students.

Depending on the sensory needs of students on the spectrum, the number of decorations in the classrooms could be either be overwhelming or tolerable.

The courtyards would help students on the spectrum run around during class time while still being visible to the teacher.

Classroom 1

Positives

1. Neutral/ natural colours
2. Retreat space
3. Natural light

Negatives

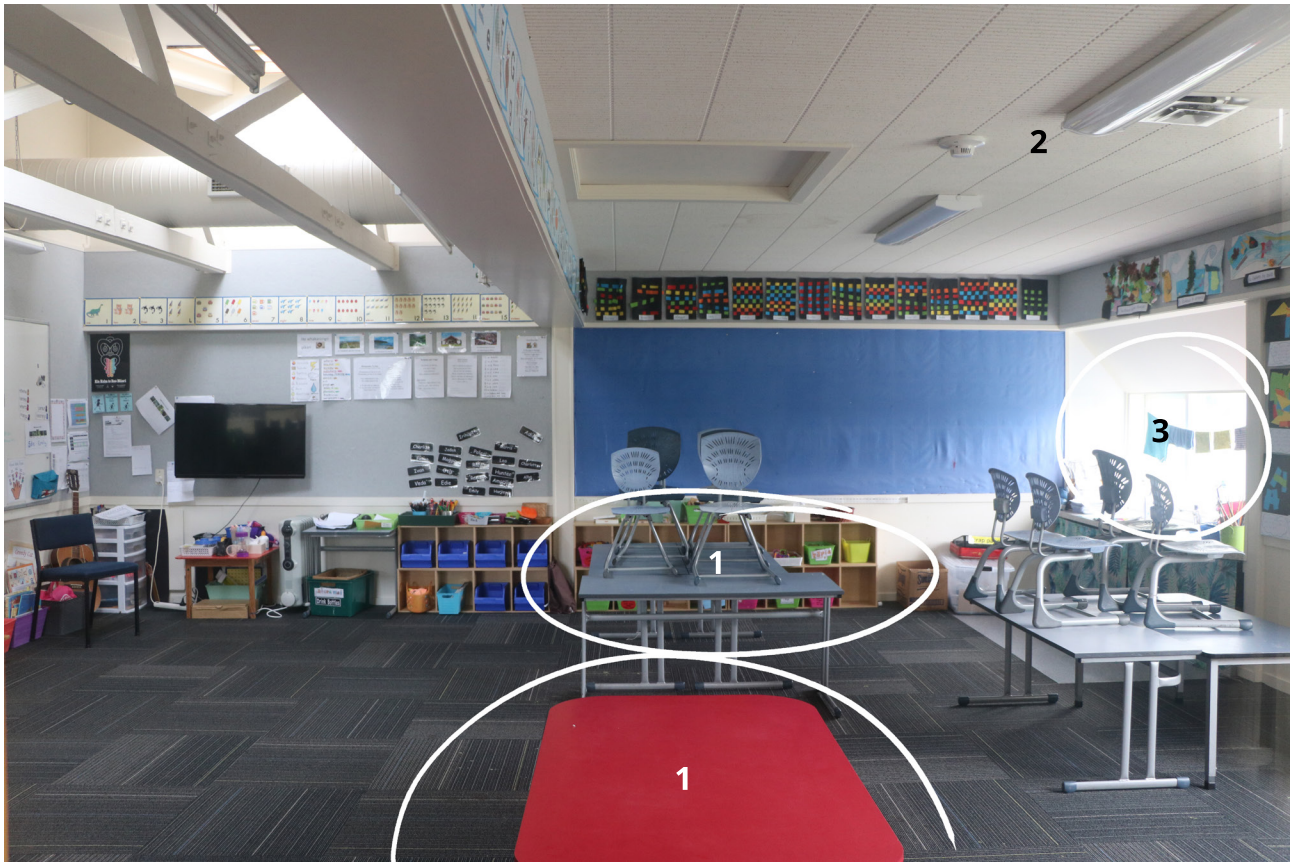
1. Bright colours
2. Decorations
3. Sightline to other classroom
4. Artificial lighting
5. No defined areas
6. No quiet area

Classroom 2

Positives

1. Neutral/ natural colours
2. Tidy storage
3. Natural light

Negatives



1. Bright colours
2. Artificial lighting
3. External view

Classroom 3

Positives

1. Neutral/ natural colours
2. Tidy storage
3. Natural light

Negatives

1. Bright colours
2. Artificial lighting
3. External view

4.5 Conclusion

Based on the literature review findings, both schools could benefit from removing bright colours and introducing more subdued colours. They could also better define different areas in the main learning space.

Some spaces could reduce decorations and clutter to create a tidy and calming environment.

Neither schools had blinds or curtains in the classrooms. This could make it hard to block distractions outside and within some spaces like the breakout rooms. Some method of blocking distractions while maintaining lighting and supervision of students could be investigated.

The acoustics in Berhampore School's classrooms could be improved through additional acoustic surfaces.

The primary learning spaces at Thorndon School could be divided into smaller areas to provide smaller workspaces.

Initial Design

5

5.1 Introduction

The background analysis and primary data informed the development of a design guide which would summarise all of the research's key findings in a concise format. The guide would aim to inform the design and adjustment of mainstream learning environments to accommodate the needs of students on the autism spectrum. Design iterations would be undertaken to 'test' the guide's recommendations.

5.2 Design guide

The first draft for the design guide involved compiling all the recommendations from the literature review and positive features from the case studies. These were then translated into simple sketches as visual representations. To make the design guide accesible, the design recommendations were divided into seven categories with concise titles: internal services, material and colour, form, layout, space, circulation, and outdoor space. Seven categories were considered a reasonable number as it was succinct while also demonstrating the breadth of the design recommendations.

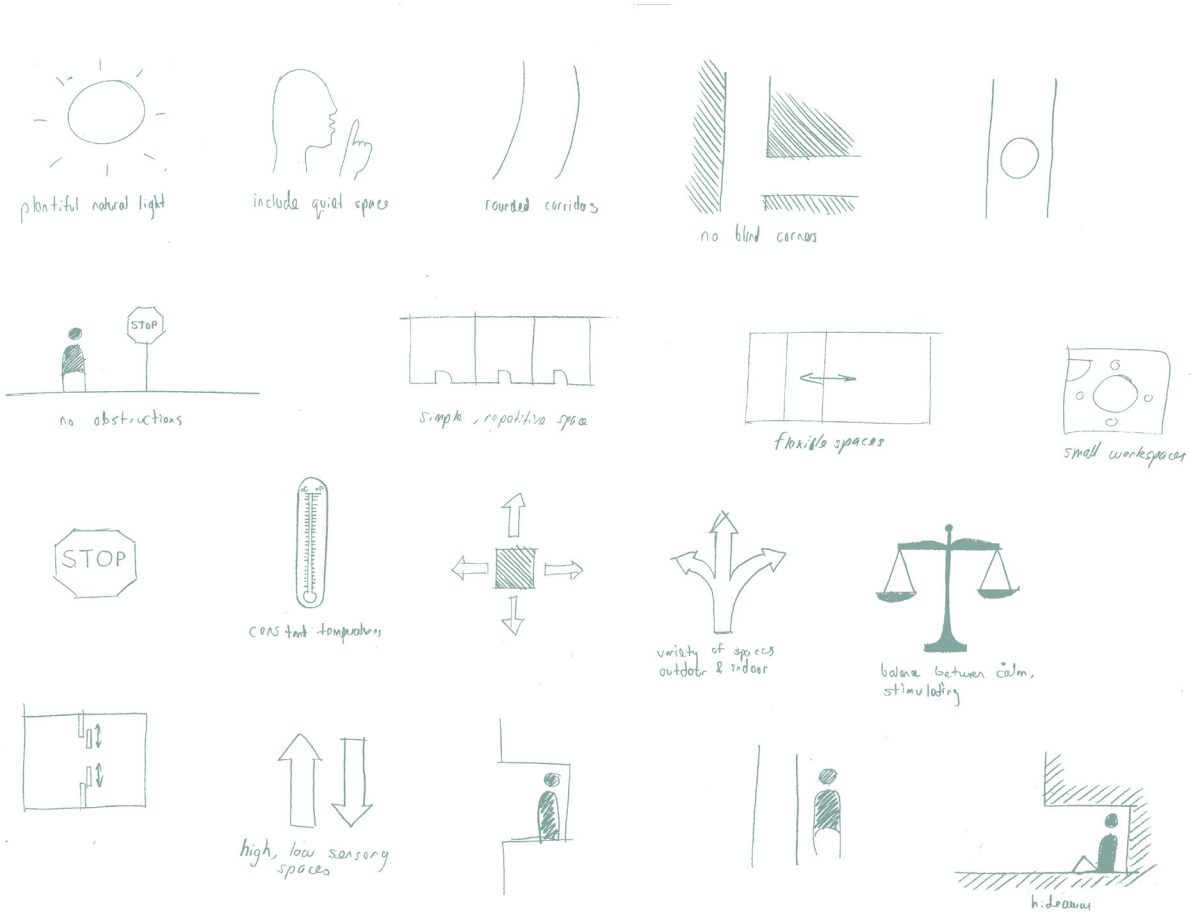
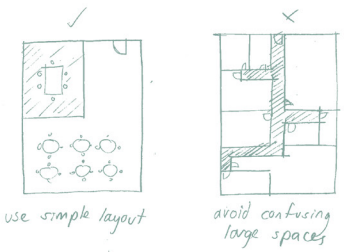
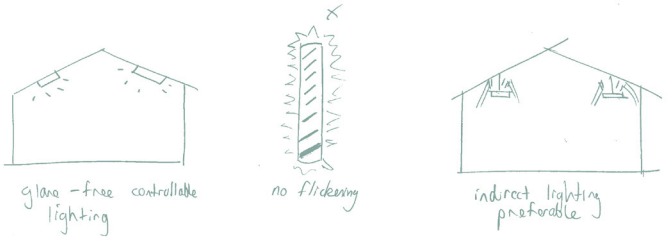
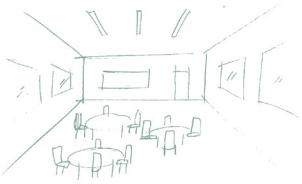
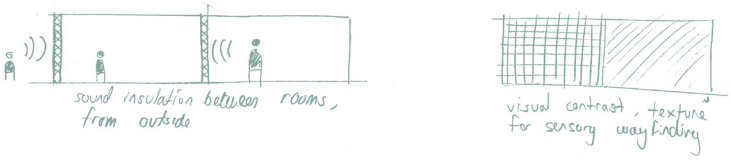


Figure 15. Design recommendations visualised


use simple layout
avoid confusing large spaces


glare-free controllable lighting
no flickering
indirect lighting preferable

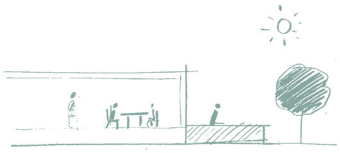

calm, ordered, low stimulus

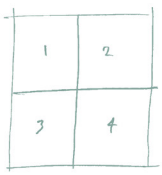

sound insulation between rooms, from outside
visual contrast, texture for sensory way finding


subdued colours


convenient travel routes, distances within school


safe indoor, outdoor spaces to retreat


outdoor spaces might be preferable


1
2
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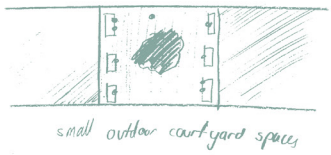
4
classroom divided into distinct areas

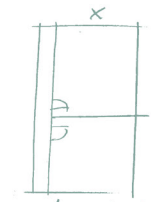

high level glazing allows light, blocks distractions

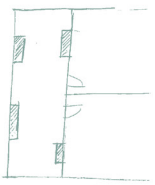

small outdoor courtyard spaces


thresholds between two different stimulus levels outside to inside


change in height influences character, mood of space


classroom environment should progress from customised in early years to neurotypical in later years


corridors should be avoided


use circulation space for socialising, self isolation

A graphic representation to encompass all the categories of the design guide was devised. Several designs were considered, and a simple umbrella symbol was chosen. It visually represents all the design categories stemming out from the central theme of autism design. The umbrella is a playful symbol, bring memories of kids in gumboots using an umbrella in the rain. Multiple concepts were developed for fonts and colours to create a fun, clean, and appealing design.

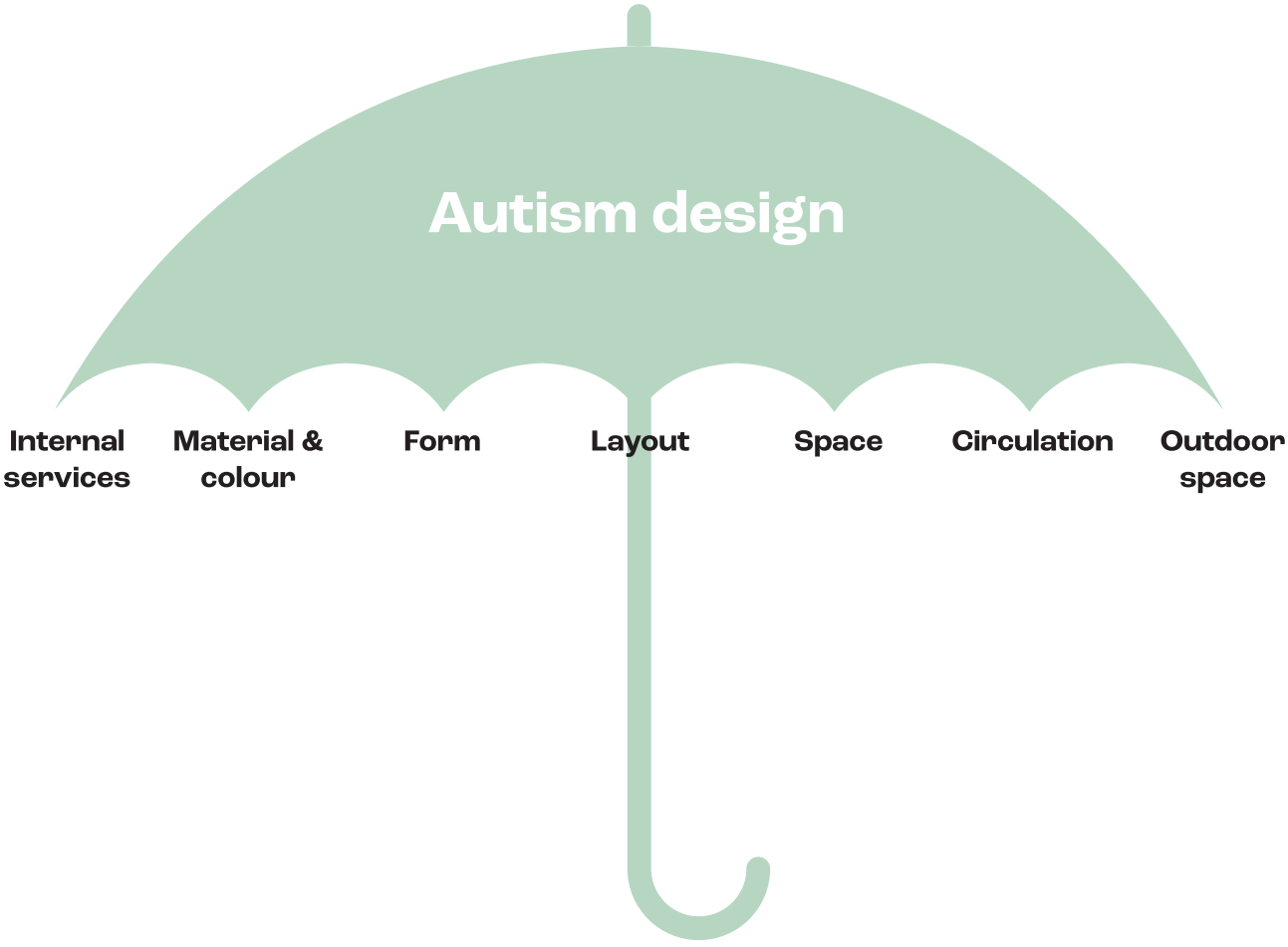


Figure 16. First iteration of design guide diagram

5.3 Colour palette

British architecture firm GA Architects have developed a colour palette for schools and residential spaces for autism. GA Architects specialise in designing environments for people on the autism spectrum (GA Architects, 2017, p.2).

Twenty colours perceived as autism-friendly were presented to autistic children between 15- 19 years old. After an elimination process, a selection of 9 colours was made (GA Architects, 2017, p.3).

The children preferred subdued colours and colours mixed with grey on the spectrum (GA Architects, 2017, p.8). Blue and green hues were popular, backed by research from Gaines et al (2014, p.293). GA Architects recommended a balance between colourfulness and greyness.

Basing their results on consultation with children on the spectrum means that this colour palette should be trustworthy to use in the design. However, the sample group used was older than the group this research is concerned with; therefore, there could be some discrepancies between both groups' preferences. It is also not stated how many children were involved in this study, so the research scope is unclear. Nevertheless, the research provides a starting point for selecting colours in the design.

These colours have also been incorporated into this research document to make it more autism-friendly.

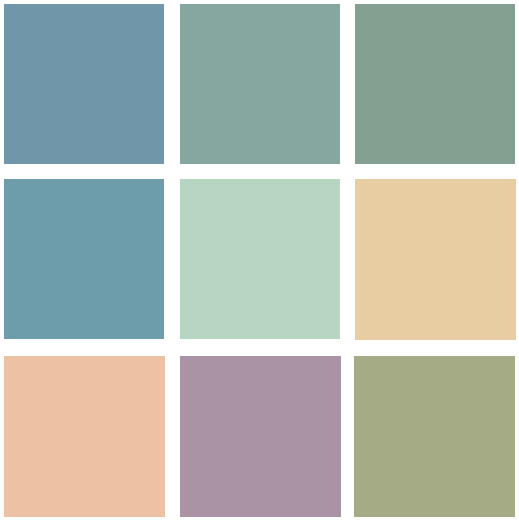


Figure 17. Autism-friendly colours

5.4 Design iterations

Four design iterations were developed as a means of testing the design guide. Designing for different contexts also helped to figure out the brief for the concept design. The short period dedicated to each design intervention meant they were only developed at conceptual stage.

Design iteration 1

The first design iteration consists of interventions for both Wellington schools that were visited. Using the results from those schools' visual analysis, design solutions were proposed to eliminate negative learning influences.

The solutions focused on changing colours, reducing room sizes, and creating quiet spaces.

Breakout room with autism-friendly colours

Blue | Green | Purple

Figure 18. Design iteration 1

Learning space split into two

Solid wall

Sliding glass doors

Bi-folding walls

Renovated classroom

Design iteration 2

The second design iteration focused on a nook design for existing classrooms. The idea was based on the notion that autistic students desire escape spaces (Mostafa, 2008, p.203–04).

Research was conducted on standard classroom building types in NZ to identify a typical size and construction. There was no data on the number of each building type produced, so it was unknown, which was the most common.

A digital model of an average classroom was created, and formed the basis of the interventions. The floor plans were analysed to locate areas for quiet study, reading nooks, caves etc. This led to the development of a furniture system built into the side of a classroom.

Form was the primary design element explored, as well as materiality. This system could work in an existing classroom or as part of a new space.

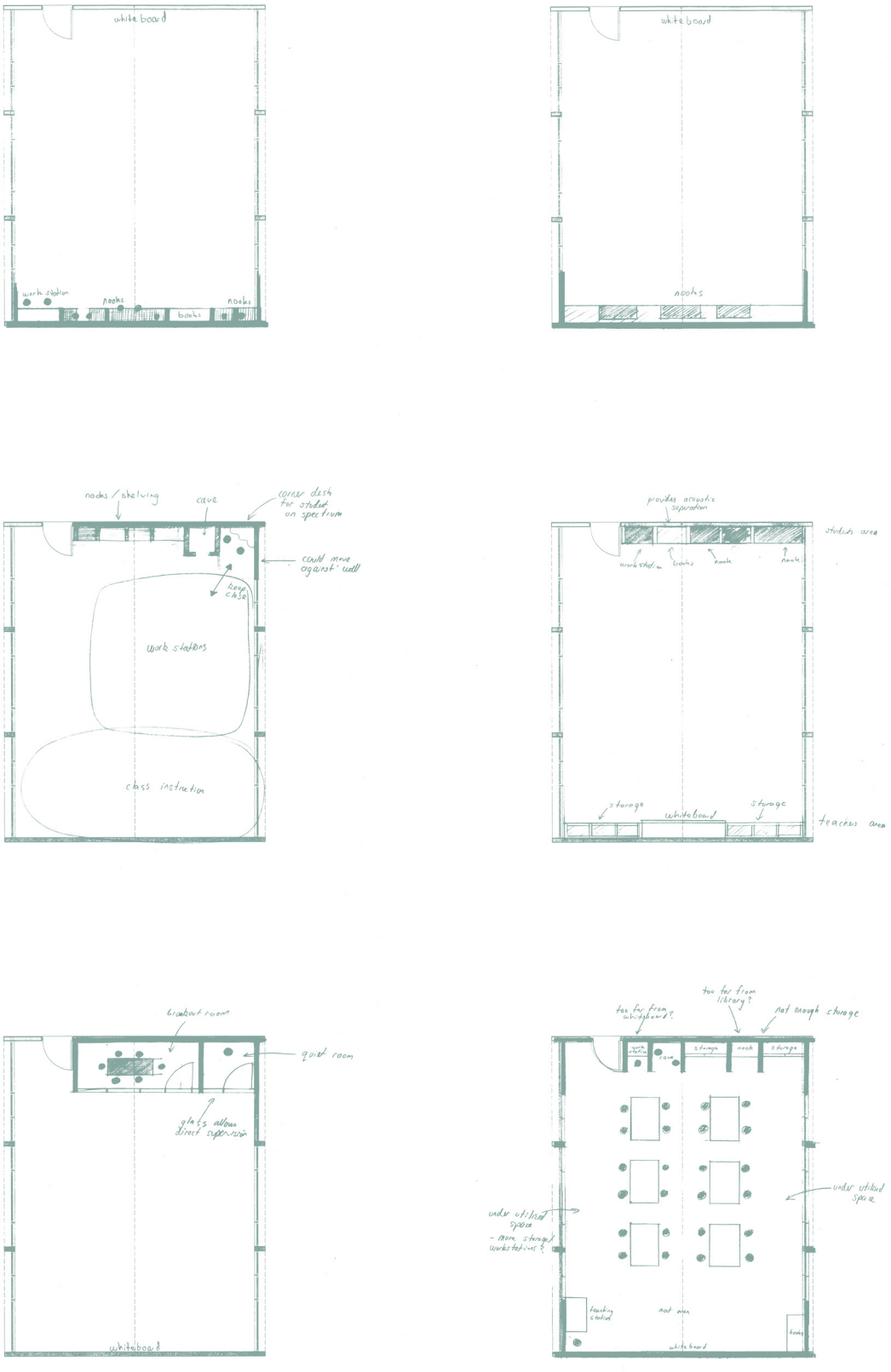
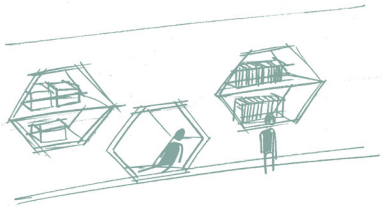
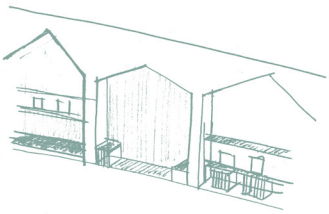


Figure 19. Design iteration 2

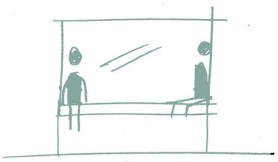
Seating nook



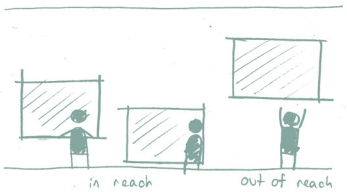
sitting / storage nooks



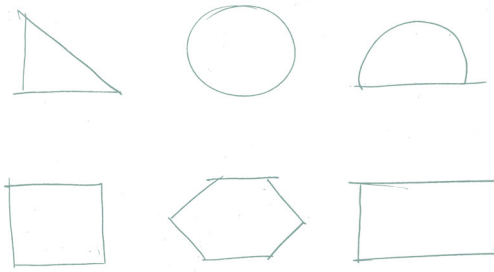
large scale nooks



window nook

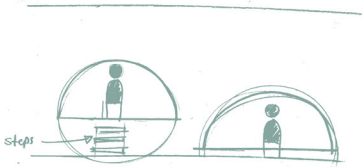


different heights

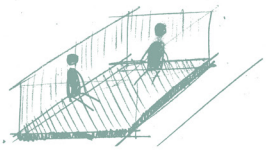


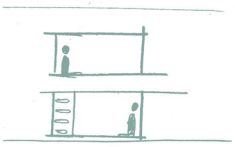
could also be used as a design motif in classroom
- acoustic panels
- carpet
- windows

shapes

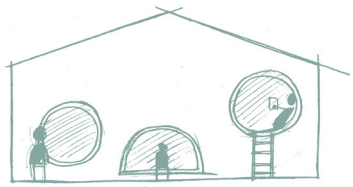


ground / offground access

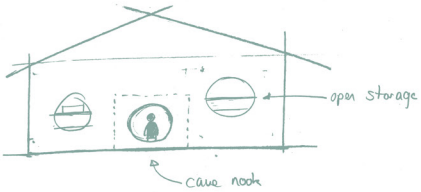


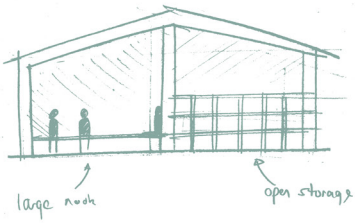


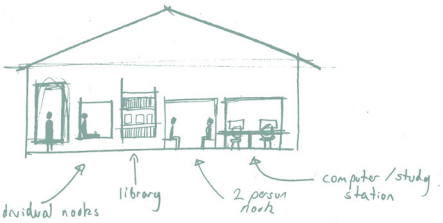
capsules

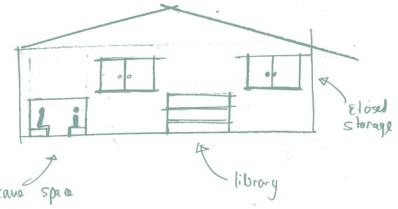


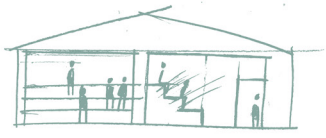
individual nooks

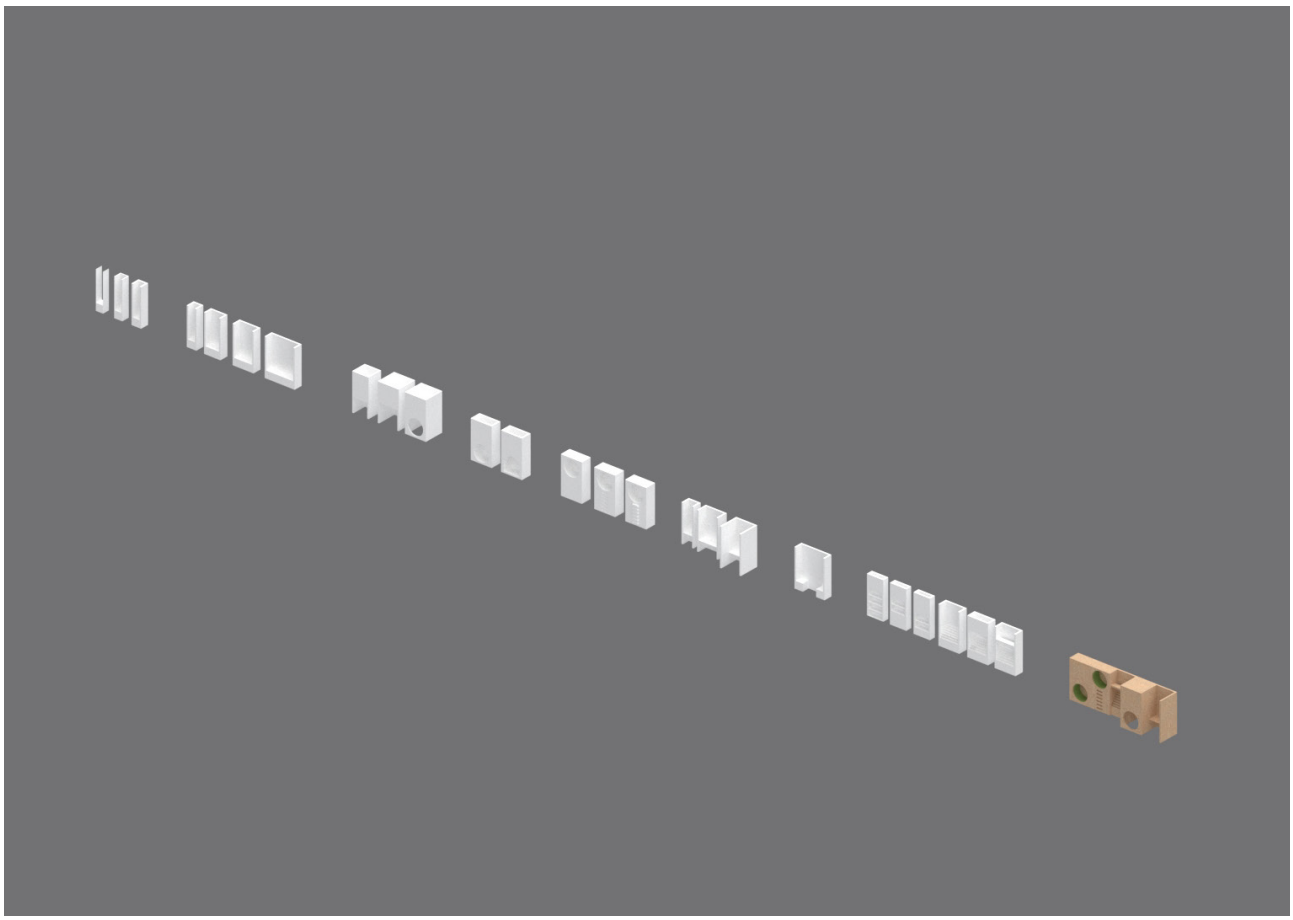


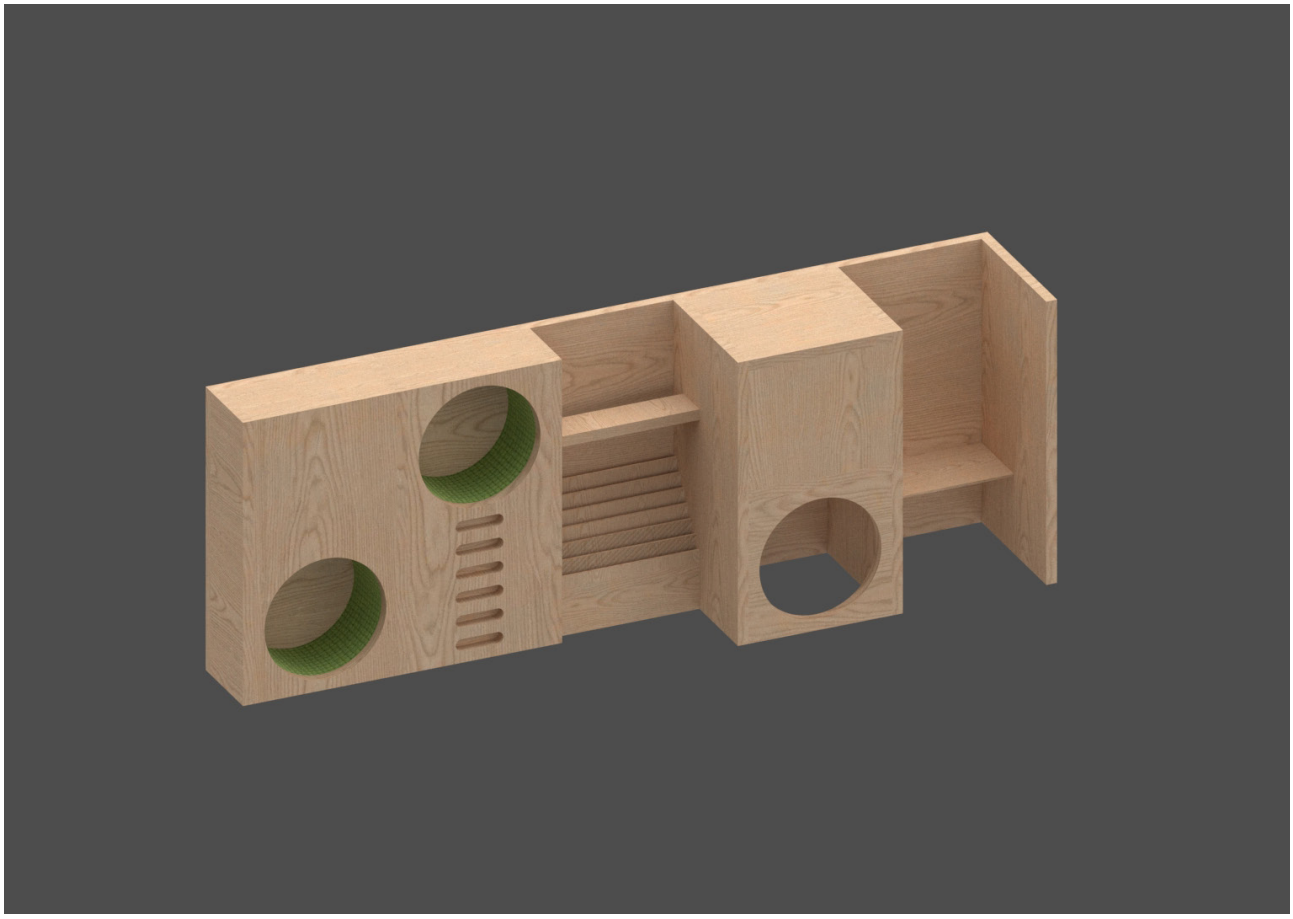












Design iteration 3

The third design iteration is for a new mainstream classroom that accommodates the needs of students on the spectrum.

The design process involved reviewing the design guide for ideas and then sketching concepts for overall shapes, roof forms and lighting infiltration. A few concepts for singular classrooms were developed before moving onto a sequence of classrooms.

Further research was conducted into allocating breakout spaces for classrooms to determine how much quiet space was required. Transition spaces were also investigated based on the design guide.

Models were made of the classroom concepts to visualise the spatial and lighting qualities.

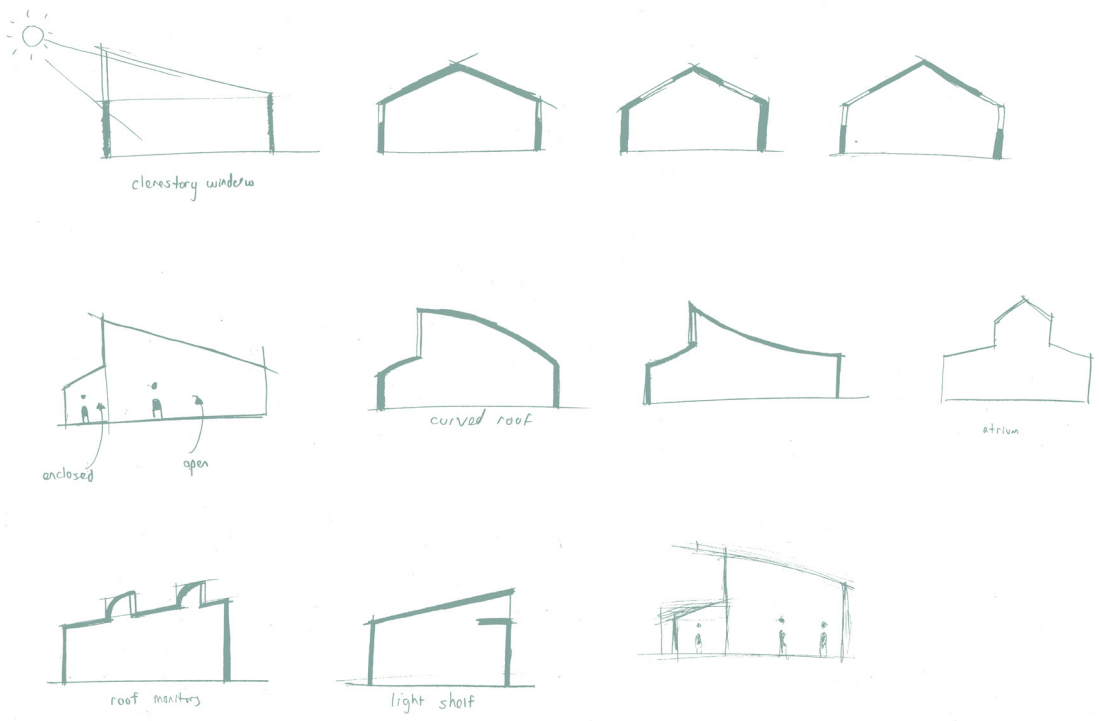
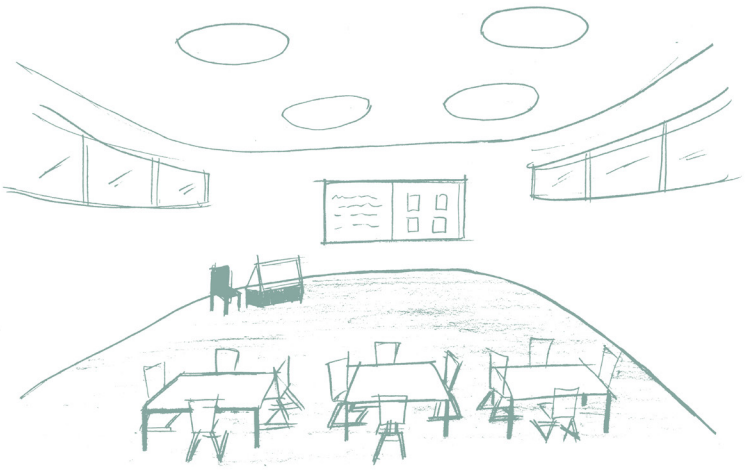
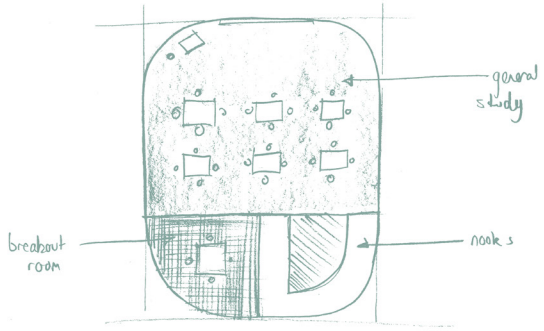
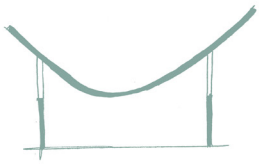
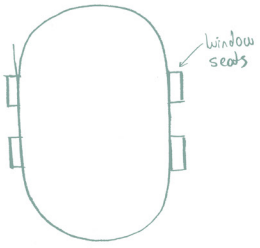


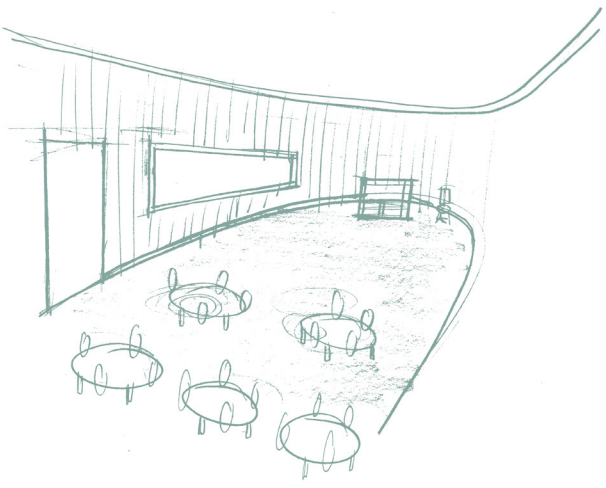
Figure 20. Design iterations 3




general study
breakout room
nooks




window seats



Design iteration 4

The final set of iterations is for a pod design. The purpose will be as a retreat space for autistic and non-autistic students.

The design process for the pod design started by selecting a surface of a classroom to attach the pod. Possible forms were sketched, and different uses for the pod were brainstormed. The original intention was to use the interior as a quiet space, and the exterior was a climbing structure. The exterior was harder to design because of concerns that children could climb onto the classroom's roof.

Models were made of the pod designs to understand the relationship with the classroom and play with different heights and volumes.

The pod developed into a standalone outdoor structure. Students could move outside to retreat to a pod when the main learning space becomes too overwhelming. The pods would have to be located close to a classroom for direct supervision.

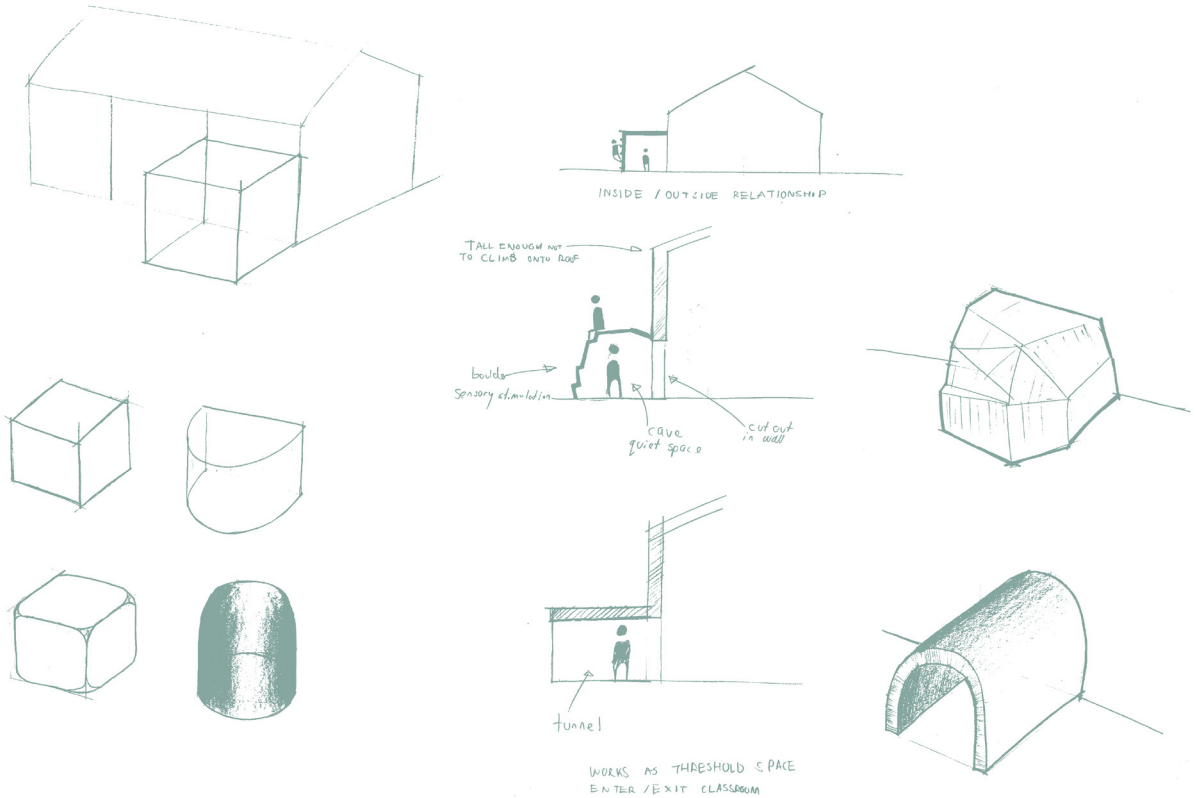
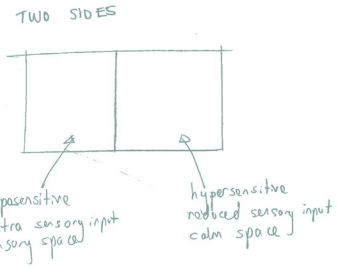
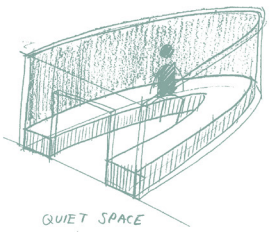
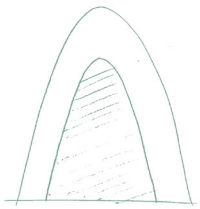
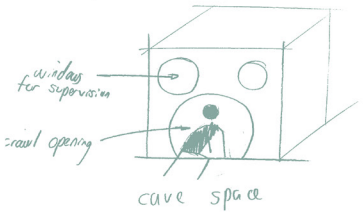


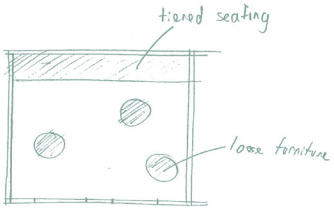
Figure 21. Design iterations 4

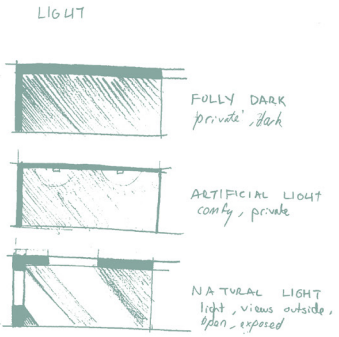

TWO SIDES
hypersensitive
extra sensory input
sensory space
hypersensitive
reduced sensory input
calm space

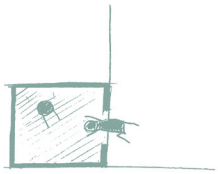

QUIET SPACE

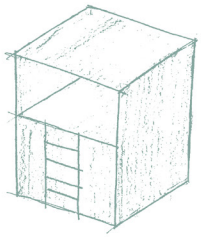


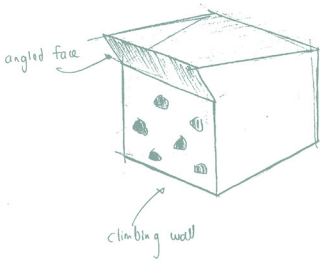

windows
for supervision
crawl opening
cave space

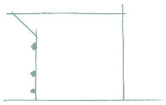

tiered seating
loose furniture

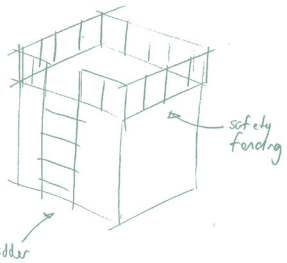

LIGHT
FULLY DARK
private, dark
ARTIFICIAL LIGHT
comfy, private
NATURAL LIGHT
light, views outside,
open, exposed

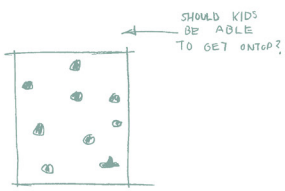


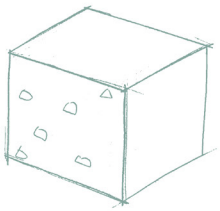


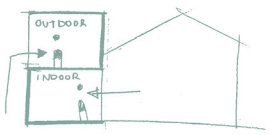

angled face
climbing wall

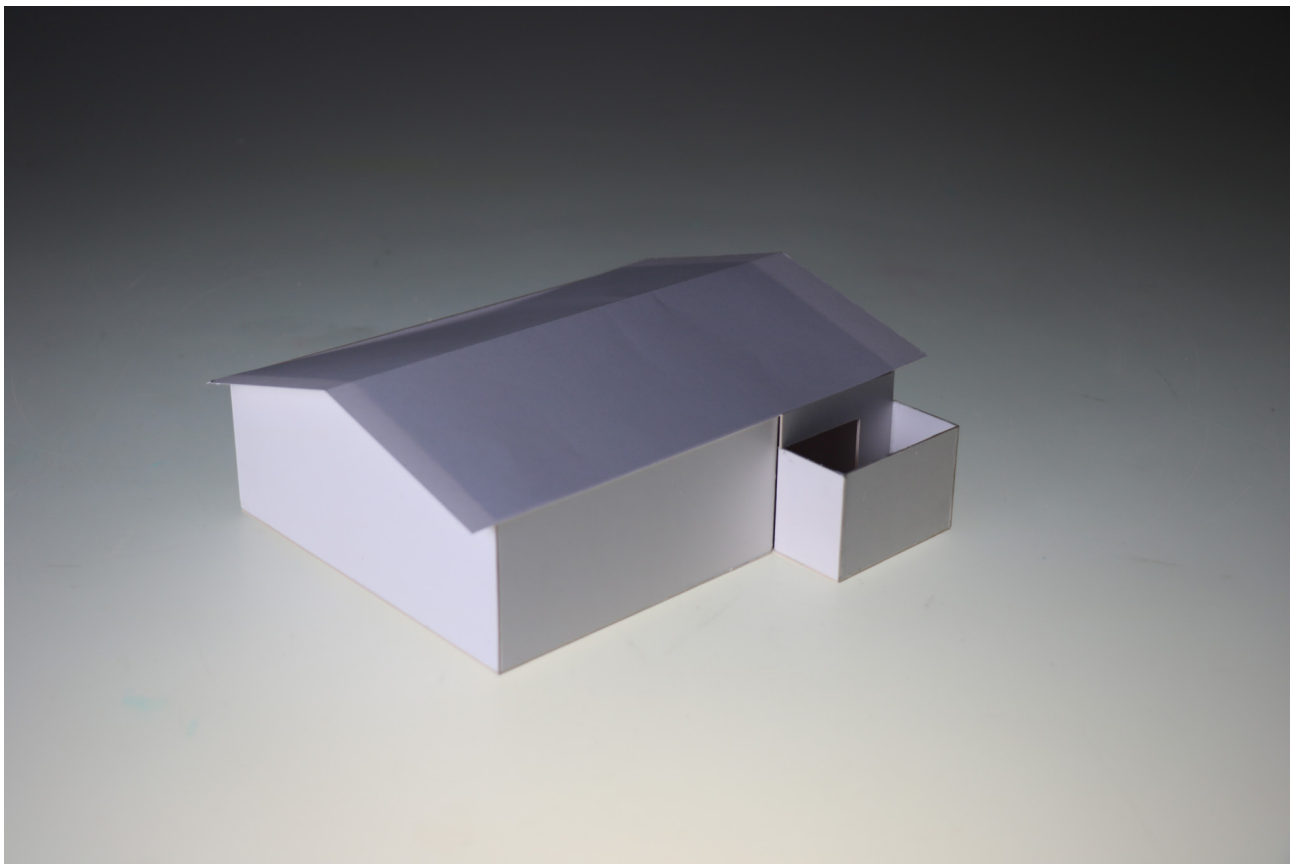


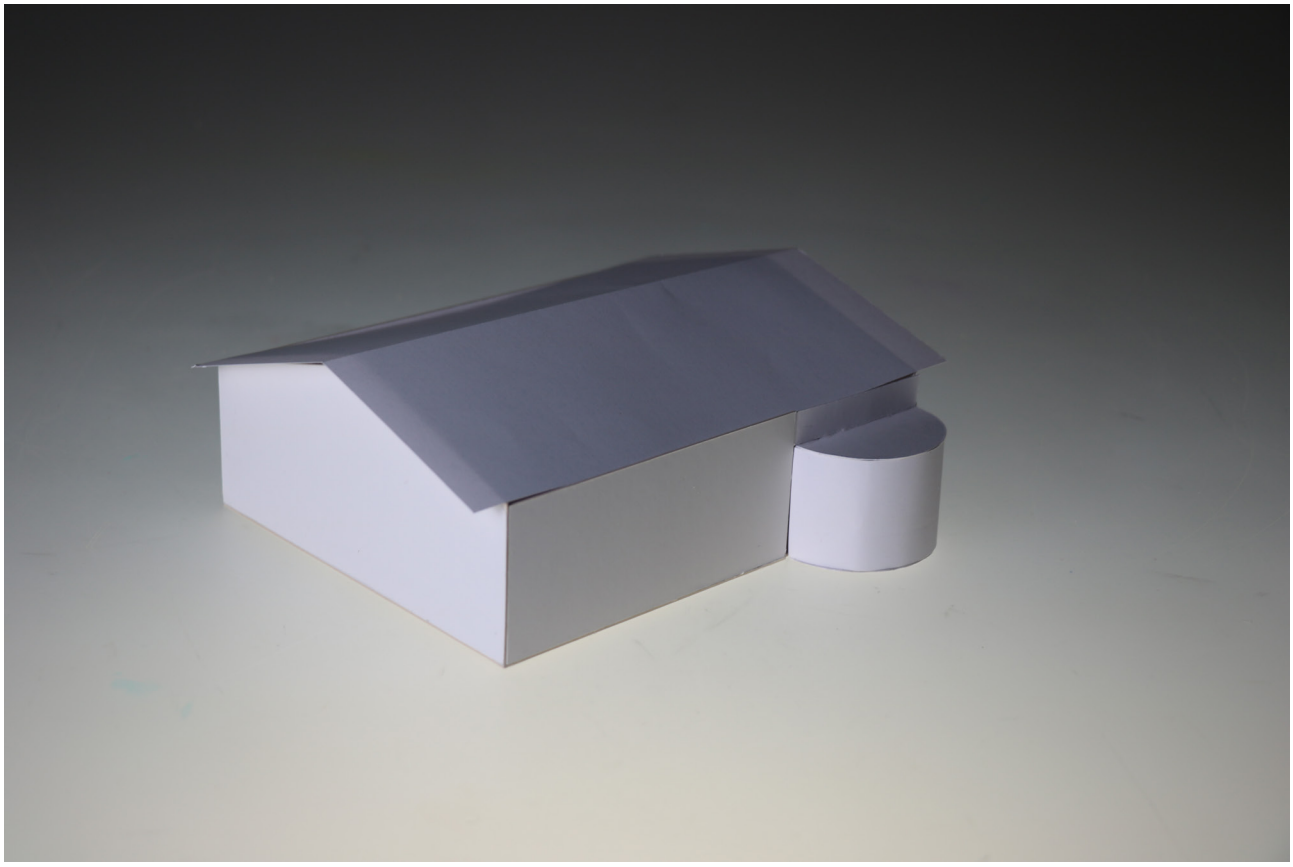

safety
fencing
ladder

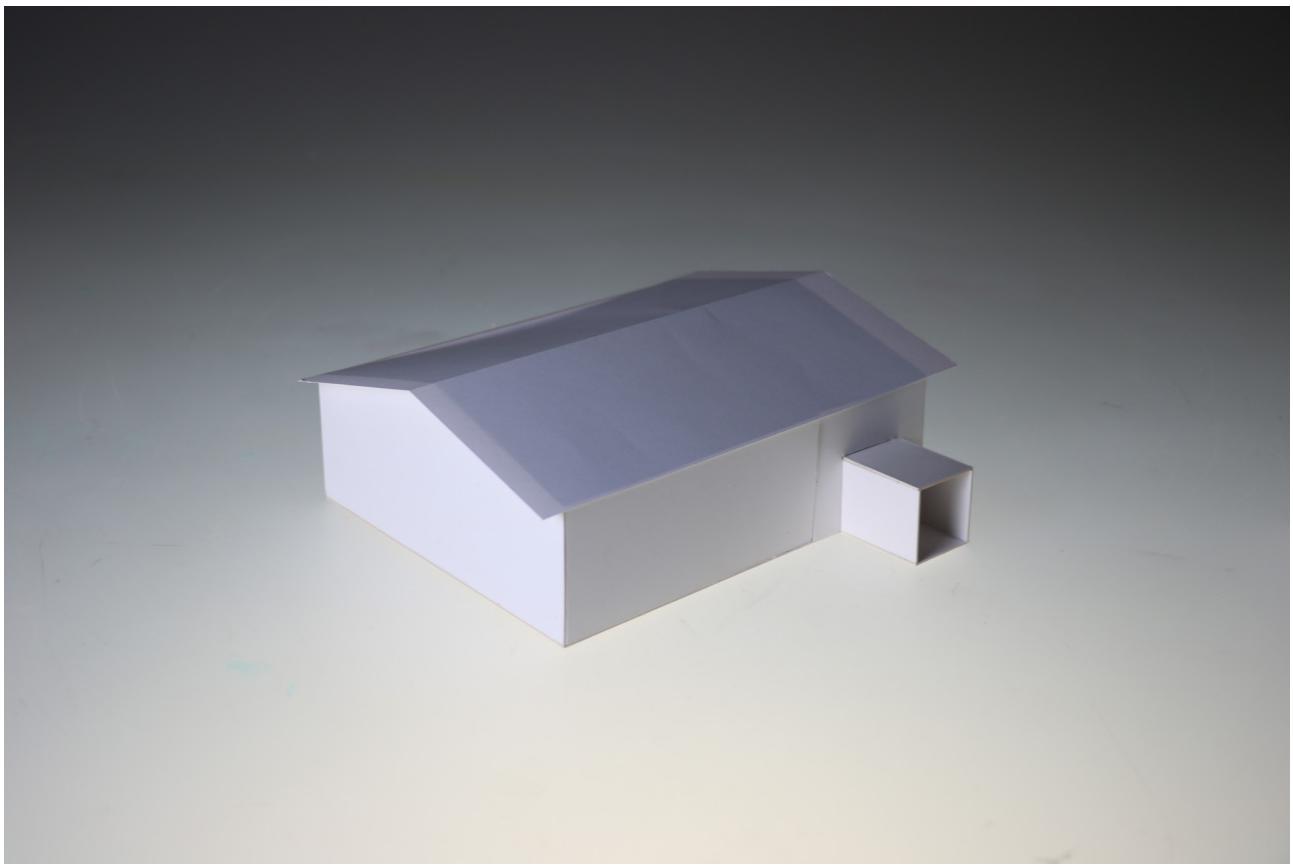

SHOULD KIDS
BE ABLE
TO GET ONTOP?

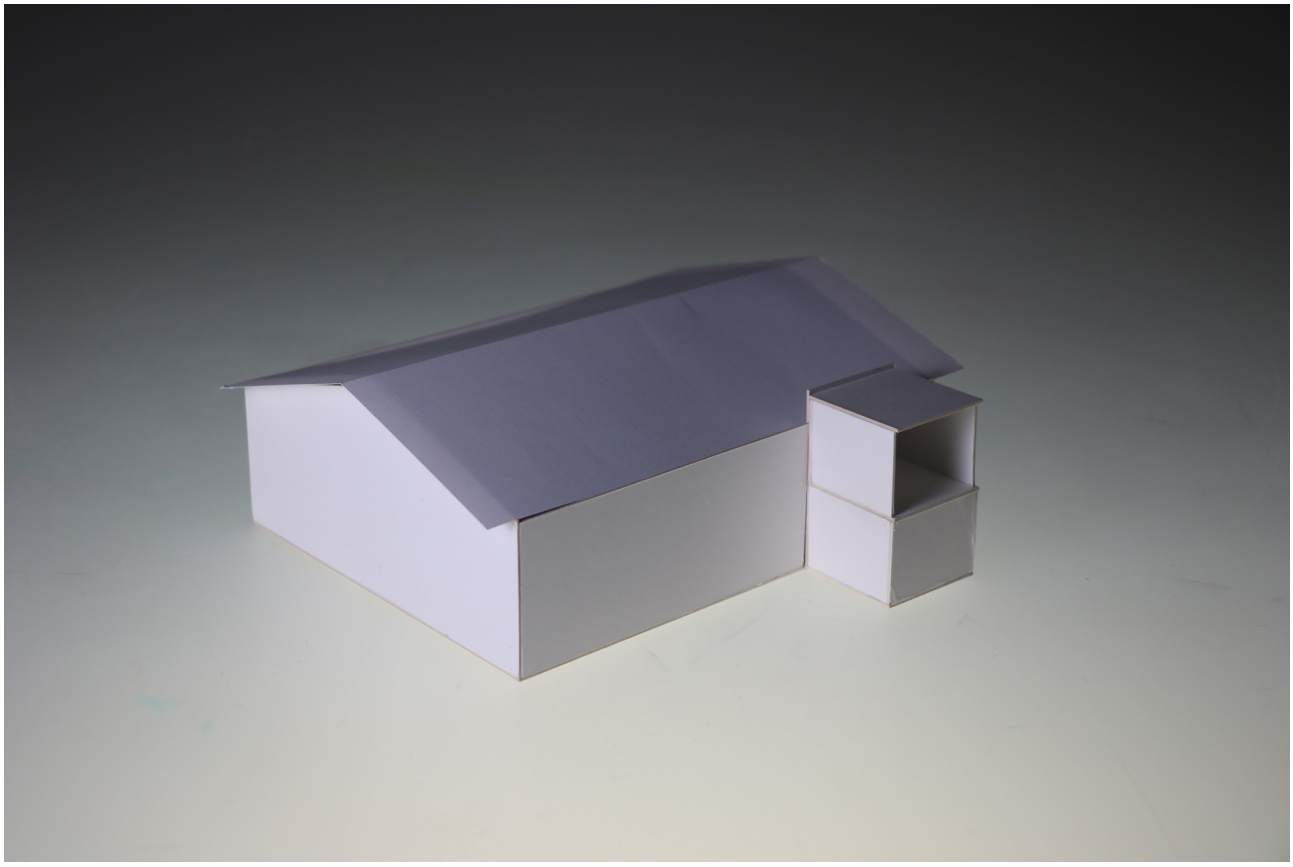



OUTDOOR
INDOOR









5.5 Conclusion

The design iterations were helpful in testing parts of the design guide. The iterations gradually progressed in considering innovative solutions and spaces that children on the spectrum would feel comfortable in.

While the design solutions in iteration one were beneficial to students, they were not radical, and the outcomes were standard.

The furniture system in iteration two was successful because it merged several furniture types into a cohesive design package. This also successfully addresses the need for hypersensitivity spaces and offers various options for students on the spectrum.

The designs in iteration three help visualise some potential forms for a classroom and attempted to diverge from the standard rectangular plan.

The pod system in iteration four successfully created a specific space for children on the spectrum and plays on the idea of escape space.

A larger design is required to test more of the design guide. There are ideas from all the iterations that could be used in further design stages, and when combined, should produce an exciting design.

Participation

06

6.1 Introduction

Because one of the study's objectives was to investigate autism and research autism-friendly design, qualitative data from teachers was considered valuable.

Teachers at primary schools in Wellington City were recruited because they have direct experience of working in primary school classrooms and teaching students with learning disabilities, such as autism. Questionnaires and small focus groups were chosen as data collection methods to ascertain how the physical design of learning environments positively and negatively impacted autistic students. Interviewing and observing students in the classroom was considered but discounted due to time constraints and ethical issues.

For ease of recruitment and to compare different school environments, teachers/ participants were recruited from within their school network. Each focus group would be made up of participants from the same school. The list of potential schools was narrowed down to schools located in Wellington City to facilitate travel for the researcher/lead facilitator.

At least two schools were considered necessary to enable comparison. It was expected there would be at least 4 participants in each focus group, but ideally between 6-10. This was based on recommendations by Lia Litosseliti in her book 'Using Focus Groups in Research' (2003, p.5). It was also expected that at least 3 focus groups in total would be conducted, but ideally, 4-6 again based on Litossesliti's recommendation (2003, p.5).

Principals of several primary schools were contacted through their email address available on their school's website. The principals were asked if they were happy for their school to participate in the research. If they were willing, individual teachers were directly contacted to ask if they would participate.

After teachers agreed to participate, they were sent an anonymous survey prepared in Qualtrics. To distribute this survey, an email containing a link was composed and sent to participants. Participants completed the survey on their devices, and once completed, the results were available in Qualtrics.

After completing the survey, focus groups were held with teachers at a location and time specified by the principal after school hours. The focus group questions are based on the impact of the classroom's social and physical environment on autistic students.

The Victoria University of Wellington Human Ethics Committee (HEC) approved the ethics application (no.28487) to conduct research with primary school teachers in Wellington City. The HEC also approved an amendment to the ethics application to include teacher aides in the study. However, there were no responses from teacher aides at either of the participating schools. Undoubtedly, the COVID-19 pandemic impacted the number of participants, but the findings were considered valid and are therefore included in this thesis.

Please refer to Appendix 2 for all HEC documentation.

6.2 Questionnaires

Nine primary school teachers from 2 primary schools in Wellington city completed an anonymous survey created on the Qualtrics web service. The survey was distributed before the focus group to provide background information that could inform the more in-depth discussion.

All the participants agreed that a classroom space's physical design could positively impact all students' learning. The most common examples were having lots of space and having quiet spaces.

89% of participants believed that the physical design of a classroom space could positively impact the learning of students with autism. 11% thought it maybe has a positive impact. The most common example of physical characteristics of a classroom space that positively impact the learning of students with ASD was having a quiet/safe space.

All the participants agreed that the physical design of a classroom space could negatively impact the learning of students with autism. The most common examples of this were too noisy spaces or bad acoustics, not having a quiet/ safe space and overcrowded spaces. Interestingly, 56% of participants listed the same examples for both autistic and non-autistic students. This indicates that both groups can be negatively affected by the same physical conditions of the learning space.

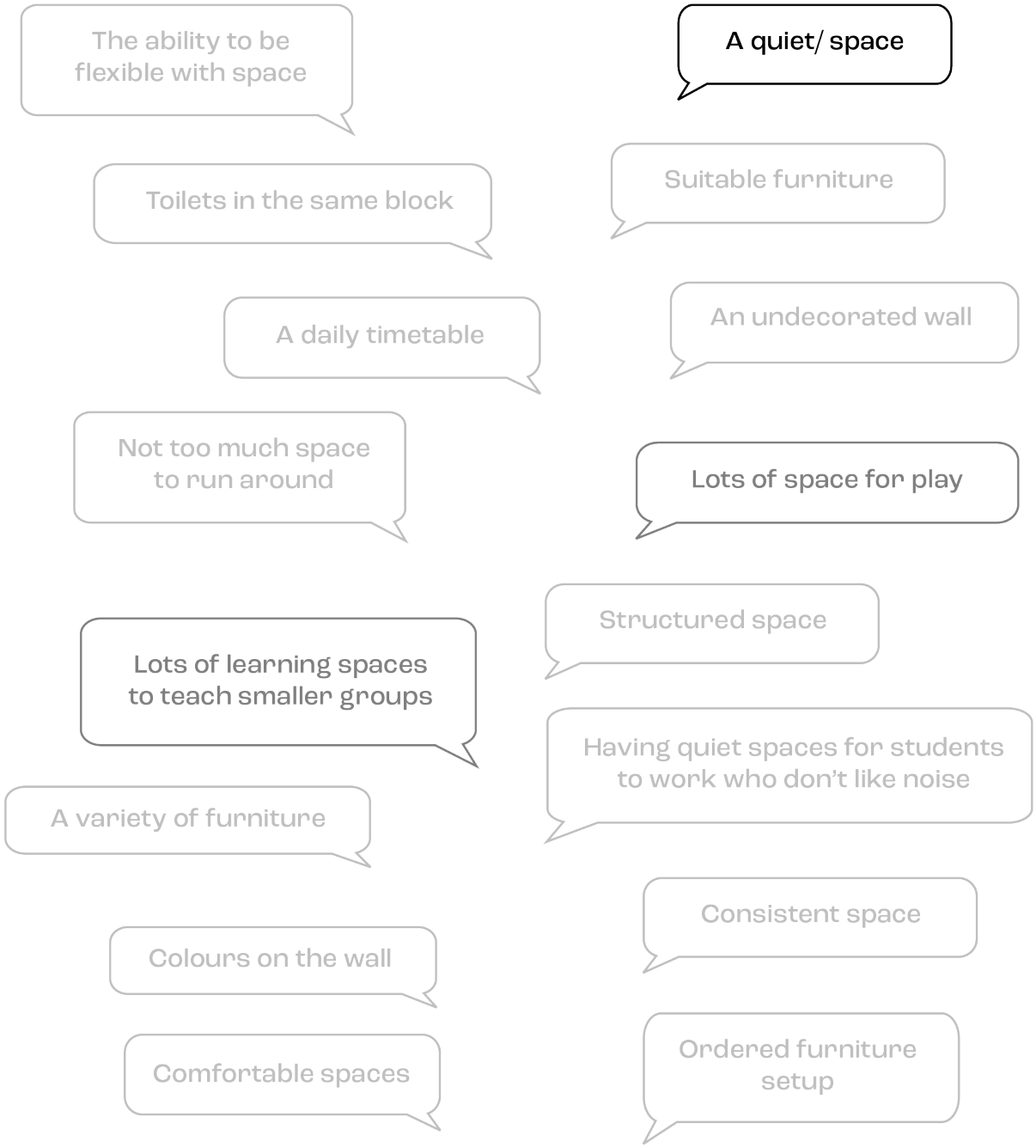
Interestingly, most participants believed that their school's physical design might support the learning of autistic students. 11% said it was supportive, and none said it was not supportive. This indicates that the learning environments had positive and negative aspects, so they were not entirely good or bad for autistic students. For example:

> ***"Some aspects are [positive], and I am sure some are not. We have little break out rooms, which are great spaces to cater for quiet chill-out times and or group work. Some of our classroom wall colours are extremely bright, which might not be so positive."***

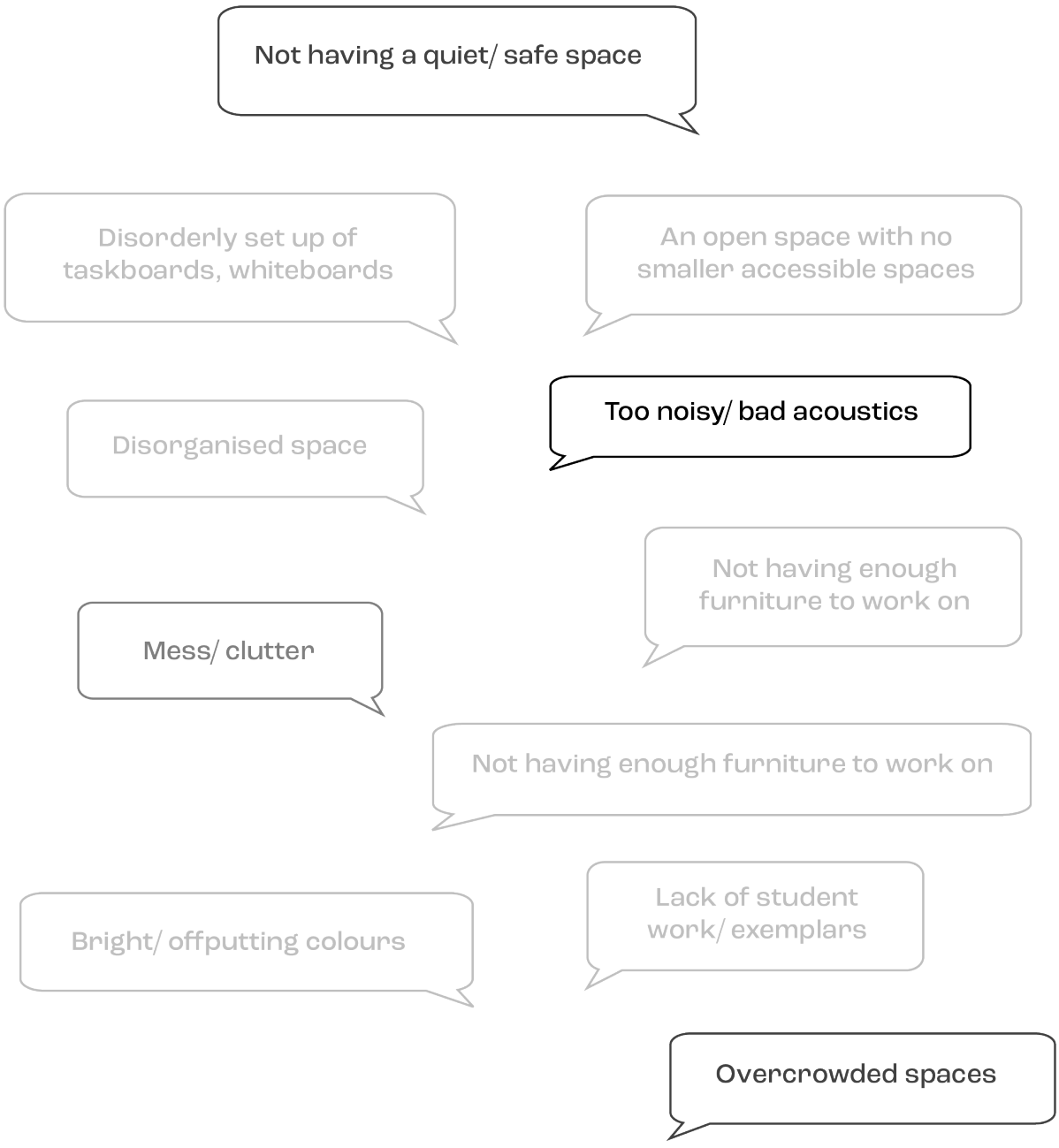
Positive aspects included access to outdoor space, break out rooms and clear separation between different play areas. Negative aspects included the school not being fully gated, not having enough small spaces and not having enough furniture.

Please refer to Appendix 3 for further results from the questionnaires.

What do you feel are the physical characteristics of a classroom space which would positively impact the learning of students with autism?



What do you feel are the physical characteristics of a classroom space which would negatively impact the learning of students with autism?



6.3 Focus groups

Focus groups were conducted at two primary schools in Wellington City on 23rd July 2020 and 10th August 2020. The sessions' purpose was to gain in-depth data about teachers' experiences with autistic students and gain feedback on the design guide and design work.

Overall, ten teachers were involved in the two focus groups. These sessions lasted approximately 1 hour, which was deemed long enough to have an in-depth discussion on several topics but short enough for the participants to commit to.

The sessions started with providing each participant with a printed copy of the design guide for feedback. Following this, a series of questions were asked about autistic students. Design iterations and concept designs were then presented for feedback. Because of the spacing between the focus groups, more developed design work was presented at the second focus group. Time for additional comments and questions was also planned for at the end of the focus groups.

Design guide

The teachers overall supported the recommendations included in the design guide. Several teachers provided firsthand experiences based on specific recommendations.

Some of the recommendations were unfamiliar to teachers, and the rationale behind them was asked for. This suggests that the design guide could benefit from including some further explanations about the recommendations.

Participants agreed that many of the recommendations were not reflected in their teaching environments and that their teaching spaces could be improved for autistic students.

One participant thought that the design recommendations should be considerate of cost:

> ***"If you are designing and going to give this to the Ministry [of Education]...you need to bear in mind about the cost because I think that's really bottom line for the Ministry... So if you can get some things in that they would choose make sure that they're cost-effective. Otherwise, they'll just say no, and then the kids have no chance."***
> Participant, focus group 1, 23/07/2020

Key characteristics of autistic students

When asked about the key characteristics of autistic students that the teachers had taught, the teachers stressed that they were vast and varied among students.

Some characteristics of autistic children that the participants had taught included:

- Being noncommunicative
- Being very talkative
- Being obsessed with an interest
- Being highly intelligent
- Underperforming academically
- Lacking skills in English, reading , writing
- Having emotional outbursts
- Inability to focus often on specific tasks
- Not liking noise
- Liking to hideaway
- Having social issues e.g. not able to make friends as easily
- A tendency to work alone
- Struggling to work in a group
- Having parents also on the spectrum

These characteristics are in line with the literature (Gaines et al., 2016, p.24–29).

The learning environment

One of the schools had a modern learning environment with 60-70 students taught between 3 teachers. The other school had a mixture of single-cell classrooms and sets of two single-cell classrooms joined by sliding glass doors. Both schools had breakout rooms for small groups.

Both schools promoted student-centred learning rather than being teacher-centred. According to one participant, the children at both schools were free to sit wherever they wanted because it was "a big part of their independence", according to one participant. Students at both schools could choose to use tables and chairs or sit on the mat. Breakout spaces and outdoor learning decks were also available at both schools.

Working preferences

Areas where autistic students worked varied. Participants said that:

> ***"They generally find a space that they like."***
> Participant, focus group 2, 10/08/2020

> ***"They go back to the same places ...they like the repetition of the same place."***
> Participant, focus group 1, 23/07/2020

> ***"[Autistic students like] smaller rooms where there's less noise."***
> Participant, focus group 1, 23/07/2020

> ***"It's providing a lot of variety of spaces that they can work in."***
> Participant, focus group 2, 10/08/2020

Autistic students' ability to work in a group varied, but some find it difficult. Some students prefer being alone, while others will socialise.

Mainstreaming

The autistic students at both schools were mainstreamed with the other students, and the participants agreed it was important for autistic students to be involved with other children in learning activities:

> ***"We wholeheartedly agree that children be mainstreamed...but it's all about the support they've got."***
> Participant, focus group 2, 10/08/2020

Support

The support provided to autistic students was considered important. Both schools had teacher aides available to help autistic students. The participants also provided autistic students with additional support.

Formal training and additional funding were considered important:

> ***"I think teachers should be given more training on how to deal with them [autistic students]. As it stands, I believe teachers aren't given any formal training on how to deal with autistic students."***
> Participant, focus group 1, 23/07/2020

> ***"I think there should maybe be more assistance from the government and things like that for a child that's severe. We can't have one teacher aide for three autistic children. In some cases, you might need 1 to 1 support the whole time."***
> Participant, focus group 1, 23/07/2020

Adjustments to the learning environment

When asked if they had ever adjusted their learning environment to help autistic students, some of the responses included:

> ***"Recently, I've adjusted my space to have lots of small tables with lots of small activities, with smaller groups instead of like a big bunch of tables together. And that seems to be working well for all children, not just for autistic children"***
> Participant, focus group 2, 10/08/2020

> ***"I had a kid who had anger management issues. Very serious. If someone said the wrong thing in front of him, he'd just spark. So we gave him a desk which is just in the corner away from everyone else. And if he was working, no one was allowed to talk to him. He could go there and could be ignored. So that worked for him."***
> Participant, focus group 2, 10/08/2020

Size of the learning environment

Participants agreed that large modern learning environments were not suitable for autistic students.

Comments about modern learning environments included:

> ***"We find with our [autistic student], especially when it's getting too noisy she hides away in the blue room or in the library corner. That's where she hides to avoid work and also because she finds it quite overwhelming with all the children because it's a lot of children."***
> Participant, focus group 1, 23/07/2020

> ***"I've recently relieved at school in Wellington that's fully modern learning... I personally felt that autistic and non-autistic children found it quite overwhelming"***
> Participant, focus group 2, 10/08/2020

> ***"I think the spaces are too big and there's too many children. And it means that teachers end up dealing with more issues regardless of whether you have a group of students that are connected to you. I think students slip under the radar more easily...those that need support don't necessarily get that."***
> Participant, focus group 1, 23/07/2020

This situation also affected students with other learning difficulties such as ADHD and defiance disorder.

The teaching might also contribute to issues with modern learning environments.

The participants in one of the focus groups believed that two single-cell classrooms joined together, like the ones they were teaching in, were ideal.

Learning environment design

Noise levels were highlighted as a major concern in learning environments:

> ***"I think the biggest thing is the noise level if you're not in control of that noise level, and that's not going to matter in a single cell or [a modern learning environment]."***
> Participant, focus group 2, 10/08/2020

> ***"We have a child who's autistic who wears headphones all the time in the space... to drown out the noise."***
> Participant, focus group 1, 23/07/2020

Classroom concept designs

Several concepts for a single cell classroom were presented to both focus groups.

In general, a classroom with a breakout space and regular-shaped walls was preferred.

Individual desks facing a whiteboard was considered outdated. Instead, there should be various tables with different shapes and heights for children to choose from. Tables should also be spread throughout the learning space.

Curved walls or a large proportion of glass walls were considered problematic because teachers cannot put up artwork. Teachers have to put things on the walls, so usable wall space was deemed essential. Participants preferred straight walls and 90-degree angles.

An L-shape classroom plan was considered unusual in NZ, as rectangular-shaped classrooms were the norm. The MoE allows a minimal footprint for classrooms, so realistically the breakout would not be able to jut out.

Having an outdoor learning deck was mentioned, as the participants agreed that students enjoy using this type of space.

The importance of storage was stressed, and there needed to be more storage provision in the concepts.

Other considerations included moving the bag storage outside, having extra sinks for handwashing and removing walls that might create blind corners.

Nook concept design

A render of the nook module system was presented to both focus groups for feedback.

The participants liked the concept but had concerns about how much space it would take up. For the number of children using it, the nook design would take up too much space. The participants thought it would be more suitable in a modern learning environment than a single cell classroom because of its size.

Storage space should also be incorporated into every available area of the nook.

Outdoor pod concept design

Sketches and a model of an outdoor pod were presented to both focus groups for feedback.

The participants liked the concept and agreed that children would enjoy it because they like crawly spaces. Concerns were raised about how it will be cleaned, how it would be supervised, and how children would be removed if they didn't want to leave. Autistic children are known to hide, and so they might use the pod to hideaway from teachers.

Additional comments

The participants commented on how interesting they'd found the research. One participant said:

> ***"We ask [how to make inclusive spaces] a lot as teachers to higher up people, so it's definitely relevant"***
> Participant, focus group 1, 23/07/2020

Another participant said of their school:

> ***"Our school just won an architecture award, but they really haven't catered for autistic children...so obviously it's not even part of the criteria"***
> Participant, focus group 1, 23/07/2020

6.4 Discussion

The results from the questionnaire and focus groups' cannot be considered a general representation of every NZ teacher's experience teaching autistic students. Despite the small sample size, the responses, do provide some rich data that would otherwise be inaccessible, and it's inclusion in this research is deemed valid.

It is assumed that only teachers who had experience with autistic students or interested in the subject wanted to become involved in the study. This is because all but one of the participants had experience teaching autistic students.

The questionnaire has confirmed the importance of having quiet/safe spaces for autistic students. It has also confirmed the importance of quality acoustics.

The unanimous agreement among the participants that the physical design of a classroom space can negatively impact the learning of students with autism was expected.

There were many similarities between the physical characteristics of a classroom space which would positively impact the learning of all students and autistic students. The same was recorded for negative characteristics. This shows that both groups are affected by many of the same issues and that a learning space for autistic students is good for all students.

There were a few contradictory responses within the questionnaire results which was surprising. For example, a consistent space and a flexible space were both listed as physical characteristics of a classroom space that positively impact the learning of autistic students.

Some responses contradict the knowledge so far about autism-friendly design. For example, lack of student work or learning example was listed as a physical characteristic of a classroom space that would negatively impact the learning of autistic students. However, the literature review concluded that this would be a positive characteristic.

Many of the examples listed under positive and negative characteristics of the learning environment support the literature review findings, which helps support the results.
The questionnaire revealed some new ideas about learning environment design for autistic students, such as having a wall blank to provide to break from sensory information. This will lead to some new recommendations for the design guide.

It was surprising that none of the participants believed their learning environments were unsupportive towards the learning of autistic students, or at least wholly unsupportive. This does, however, correlate with the classroom analysis, which shows both positive and negative physical characteristics in the learning environments.

The focus groups reaffirmed some of the research's key points, one being that all autistic children are different, and their needs are vast and varied. It will be challenging to accommodate all those needs, but addressing the main concerns raised in the focus groups should be a priority.
The participants confirmed the importance of teaching autistic students in a mainstream environment with other children. Again, this depends on the individual's needs, and some autistic students may need to be taught separately from the other students or at a special needs school.

The sessions also confirmed that large modern environments are not suitable for

autistic students and that smaller learning spaces would be best. The idea of two adjoining single-cell classrooms could present some problems for autistic students since the flexibility of enclosing and opening between two classrooms contradicts the need for sameness. However, none of the participants raised concerns about this.

It became apparent that the learning environments the participants worked in were only partially responsive to the needs of autistic students. This correlates with the results of the questionnaire. While there were useful design features, e.g. breakout rooms, and the participants had made efforts to support their autistic students, there were detrimental features of the environment that could not be fixed quickly, e.g. poor acoustics.

The focus groups' results required some analysis of what was and was not targeted towards autistic students. Some of the ideas suggested for an improved learning environment were based on the teachers' desires and not necessarily on what students wanted. Some of the suggestions covered all the students in general, but this was useful because the research is directed towards mainstream learning environments. However, some of the suggestions might only benefit non-autistic students, such as artwork on walls.

The teachers emphasised that teaching was the most vital component of a student's learning. However, the learning environment plays an important part and therefore needs to provide the ideal conditions.

Beyond the physical design of learning environments, the focus groups also revealed a lack of financial support for autistic students and a lack of teachers' training.

Overall the design guide was well-received by the participants and did not require significant changes. There are some descriptions and drawings which would benefit from some minor alterations, and there are several new ideas that could be incorporated as added recommendations to the guide.

Lighting was not a significant concern for autistic students, according to the participants. It was surprising to learn and challenges the findings in the literature review. This could be because there were more serious problems arising, such as noise levels.

The concept designs need some development based on the participants' feedback.

6.5 Conclusion

The questionnaire and focus groups were highly successful and valuable in terms of the breadth of data and constructiveness of feedback received. The participants were passionate about the subject and eager to express their thoughts. The feedback received helped develop both the design guide and the design concepts. Several new ideas also emerged, which contributed to the design guide.

Conceptual Design

7

7.1 Design guide

More design recommendations were added to the guide after the first round of questionnaires. The numerous comments on furniture led to the creation of 'furniture' as a category.

Several recommendations concerning sensory design did not fit well under other categories and would benefit from being grouped. This led to the creation of 'sensory design' as a category.

To reduce the design categories back to seven, 'form', 'layout' and 'space' were merged into 'space'.

'Internal services' was reworded to 'indoor environmental quality' to express the category better. 'Material and colour' was also changed to 'finishes'.

The design guide was made into a booklet for feedback from the focus groups. It included a reference list of the literature review and case studies.

Based on the focus groups' feedback, slight changes were made to the wording of some recommendations for improved clarity.

Additional design recommendations from the focus groups were also included.

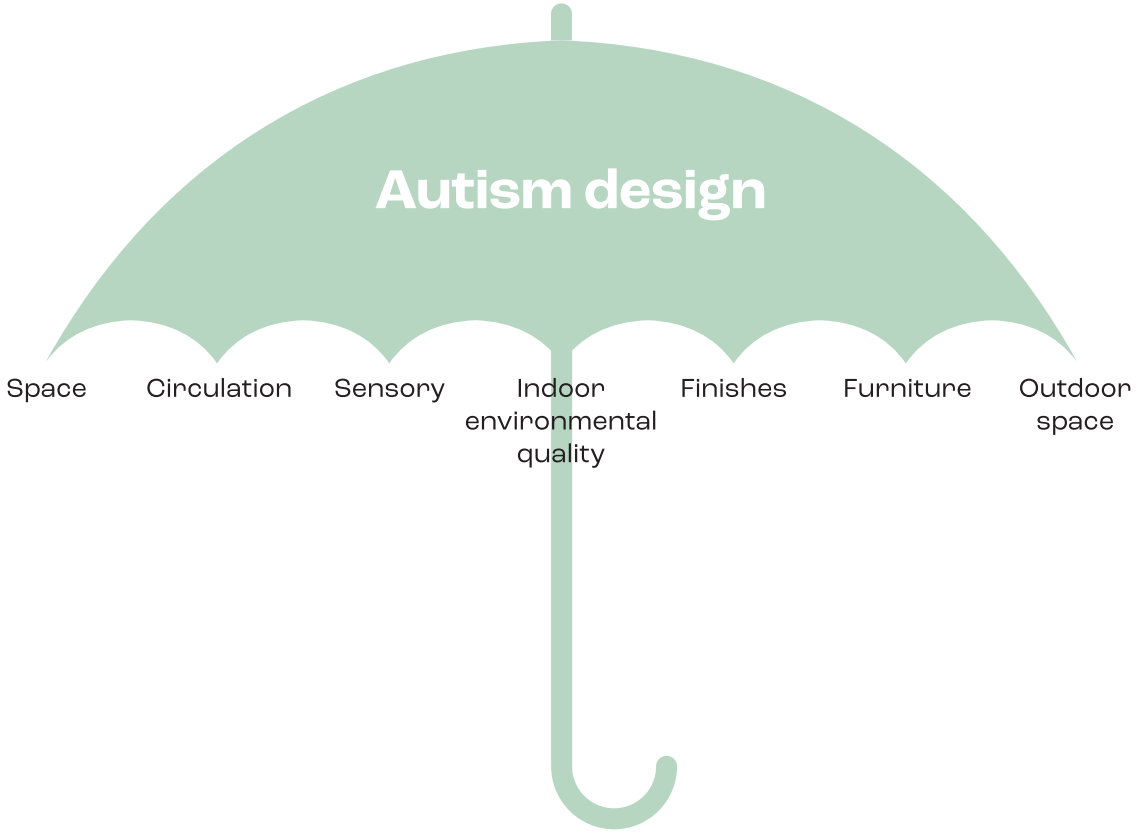


Figure 22. Second iteration of design guide diagram

7.2 Information sheet for educators

There was some consideration as to whether the design guide should be targeted towards teachers or architects or both groups. They are two completely different audiences with distinct roles, though they both desire good outcomes for students. It was decided that the guide would be solely aimed at architects. Most of the design guide recommendations are specific to the learning environment's design, meaning that they are more appropriate for architects. However, teachers and school boards may also find these helpful.

To assist educators, a specific resource targeted towards them was also devised. Titled 'Adapting existing learning environments for students on the autism spectrum', the resource aims to provide educators with recommendations for improving their learning spaces. The information was presented as a two-sided A4 information sheet. Some recommendations featured in the design guide are included due to their appropriateness to both architects and teachers. Sixteen recommendations were made, with an associated cost included. Most of the recommendations involve 'simple fixes' that are free to implement. Other recommendations require the purchase of new materials, e.g., wall coverings and light fixtures, and installers.

An overview of autism was included in the guide to give educators some awareness about the condition. The information sheet emphasises that interventions should be chosen based on the pupil's characteristics and the individual learning situation.

Information sheet page 1

Adapting existing learning environments for students on the autism spectrum

Children on the autism spectrum often struggle to cope with over-stimulating environments. This can make learning in mainstream primary schools a difficult experience, as students risk being excluded from learning activities. Adjustments to the classroom environment can help improve learning outcomes.

About autism

Autism or autism spectrum disorder (ASD) is a neurodevelopmental condition that affects communication, social interaction and adaptive behaviour functioning. ASD is an umbrella term that covers the subgroups of autistic disorder, Asperger's disorder (Asperger syndrome), childhood disintegrative disorder (CDD), and pervasive developmental disorder not otherwise specified (PDD-NOS).

Autism is defined as a triad of characteristics: social impairment, communication impairment and repetitive behaviours.

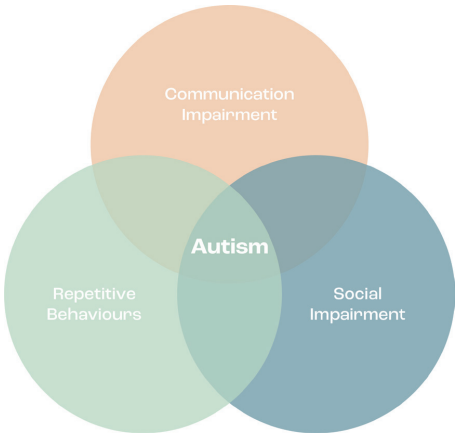


Figure: 1. The triad of impairments

Autism is a very diverse condition, therefore the group of individuals affected have a wide range of severity, disability and intellectual function.

Boys are four times more likely to develop autism than girls. The cause of autism is not known, although scientists believe that genetics and environmental influences are likely involved.

Approximately 80,000 individuals in New Zealand have autism, although many may not be diagnosed.

Using this guide

This guide has been developed following a review of literature, analysis of case studies, and conversations with primary school teachers. A list of the literature reviewed is given below. Case studies include schools and autism facilities from New Zealand and overseas. Conversations with primary school teachers took place on 23rd July 2020 and 10th August 2020 at two primary schools located in the Wellington Region.

The guide covers areas of the classroom such as space, circulation, indoor environmental quality, finishes and furniture.

Due to the wide range of sensory needs across children with autism, some suggestions may not work for particular students. It is important to consider the particular needs of the affected student in order to gain maximum benefits.

An estimated cost of implementing each strategy is included. Costs are based on a typical classroom of 62m2 floor space. Some recommendations will require the involvement of labouring professionals.

Figure: 2. Example of an autism-friendly learning environment with subdued wall coverings, ordered art displays , nook spaces and clutter less storage.

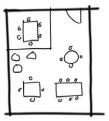
Figure 23. Information sheet

Information sheet page 2

Recommendations and estimate of cost

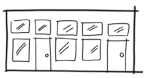
Replace fluorescent lights with glare-free soft lighting . LEDs and dimming switches are recommended.

Cost: $580 for 6 x 27w 5ft LED tubes



Arrange furniture into a simple layout. Try using small groups of tables rather than big tables.

Cost: FREE



Cover windows, doors and reflective surfaces that are distracting.

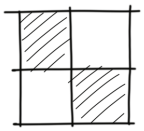
Cost: $2330 for 10 Sunscreen roller blinds totaling 23.5m2

Remove clutter from the classroom

Cost: FREE

Replace wall surfaces with acoustic wall covering for improved acoustic performance. Use subdued colours (e.g. blue and green) and avoid bright colours (e.g. red and orange).

Cost: $5340 for 68m2 of Autex Composition Acoustic Wall Covering



Divide learning spaces into distinct areas.

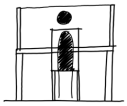
Cost: FREE

Replace flooring with carpet for improved acoustic performance.

Cost: $450 for 62m2 of carpet tiles

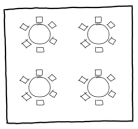
Position students away from sensory distractions (e.g) glare, loud noises

Cost: FREE



Provide a personal seating place for students. A desk with dividers can provide a sense of privacy

Cost: $327 per study carrel



Provide plenty of space for circulation around the classroom and remove obstructions

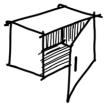
Cost: FREE

Provide a variety of comfortable, loose furniture for students to work or relax. Soft furnishings help control acoustics in the classroom.

Cost: $72 per lily pad seat, $123 per bean bag, $137-185 per ottoman

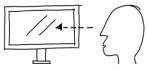
Provide a visual timetable in an easy to find location

Cost: FREE



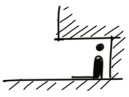
Closed storage is preferred

Cost: $800 for materials and construction of new doors to existing cupboards



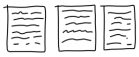
Position class computers so that the screen is visible and can be observed

Cost: FREE



Provide a quiet escape space for relief from overstimulation. If a seperate room isn't available, create a small partitioned area or corner in the classroom.

Cost: $1000 for materials and construction of a partitioned space with soft coverings



Limit student artwork and resources to a select number of wall surfaces and arrange in an orderly fashion.

Cost: FREE

TOTAL COST: $11,160

7.3 Concept design

The concept design stage provided the opportunity to test the design guide at a larger scale and in more detail. The brief was to design an inclusive mainstream primary school classroom and associated outdoor space for one class unit (25 students) in years 3-4. By defining the year group, the kinds of spaces included inside the classroom were also defined. The design process started by listing all the design considerations and requirements. The MoE's '**Designing Quality Learning Spaces**' series was also consulted.

The book '**The Language of School Design**' was used to research modern education design. The authors discuss several design patterns for a learning space, from single-cell classrooms to flexible learning environments. The 'learning studio' was deemed the most appropriate for autistic students. It offers a small-scale space while allowing for more activity areas than a single cell classroom, such as breakout rooms and outdoor learning areas (Nair et al., 2005, p.29).

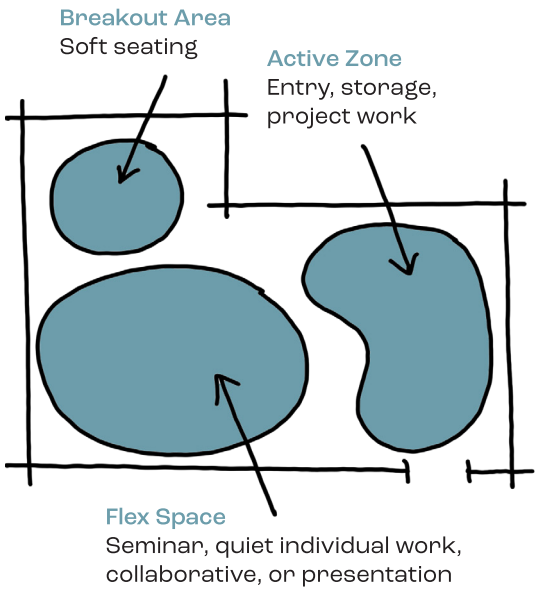


Figure 24. Learning studio design pattern

Teachers in the first focus group also desired these features.
An L-shaped learning studio was adopted, and a floor plan was developed, paying particular attention to the nook area and providing enough space for each zone. This floor plan was taken to the second focus groups for feedback.

The teachers commented on how the furniture was not suitable for flexible learning, and a variety was needed. The school used tables instead of individual desks because it allowed the children to sit wherever they wanted. They also commented that the spatial arrangement was teacher-centric when it should be designed for the students. Interior walls prevented teachers from always having surveillance over their students. The mat area was oversized and there needed to be more space between tables.

The teachers expressed a strong desire to have connectivity to a second classroom to allow collaborative learning. Realistically the area for the breakout room would not be approved by the Ministry, and an L-shaped floor plan was very unusual in NZ primary schools. The teachers suggested moving the breakout space within the learning studio's rectangular envelope or creating an outdoor learning deck next to it.

Using the teachers' feedback, four concepts for a learning studio were developed. The arrangement of the different learning spaces and changes in height were played within each concept. They all demonstrate several principles from the design guide, such as dividing learning spaces into distinct areas and including elevation changes. Each concept includes a covered outdoor learning deck to act as a threshold space from outside the learning studio to inside.

Each studio also has a connection to an adjacent studio. '**The Language of School Design**' explains that by connecting two learning studios, they can operate together as a 'learning suite' (Nair et al., 2005, p. 30). It was still essential to close off the two studios for the sensory needs of autistic students.

An outdoor pod was also developed in the concept designs. It consists of a double-height timber structure with a ladder and lookout spaces.

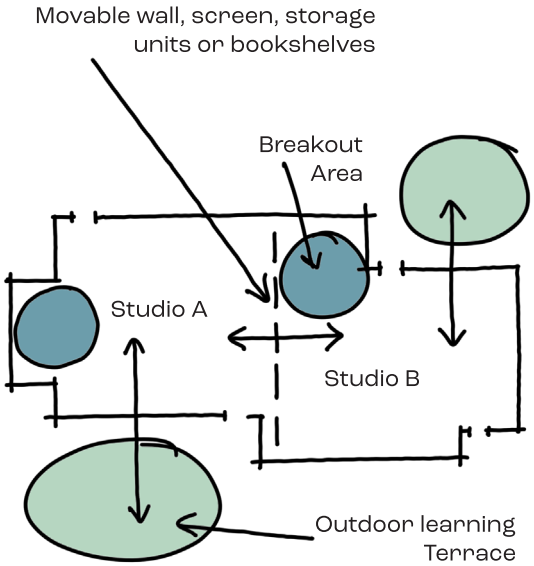


Figure 25. Learning suite design pattern

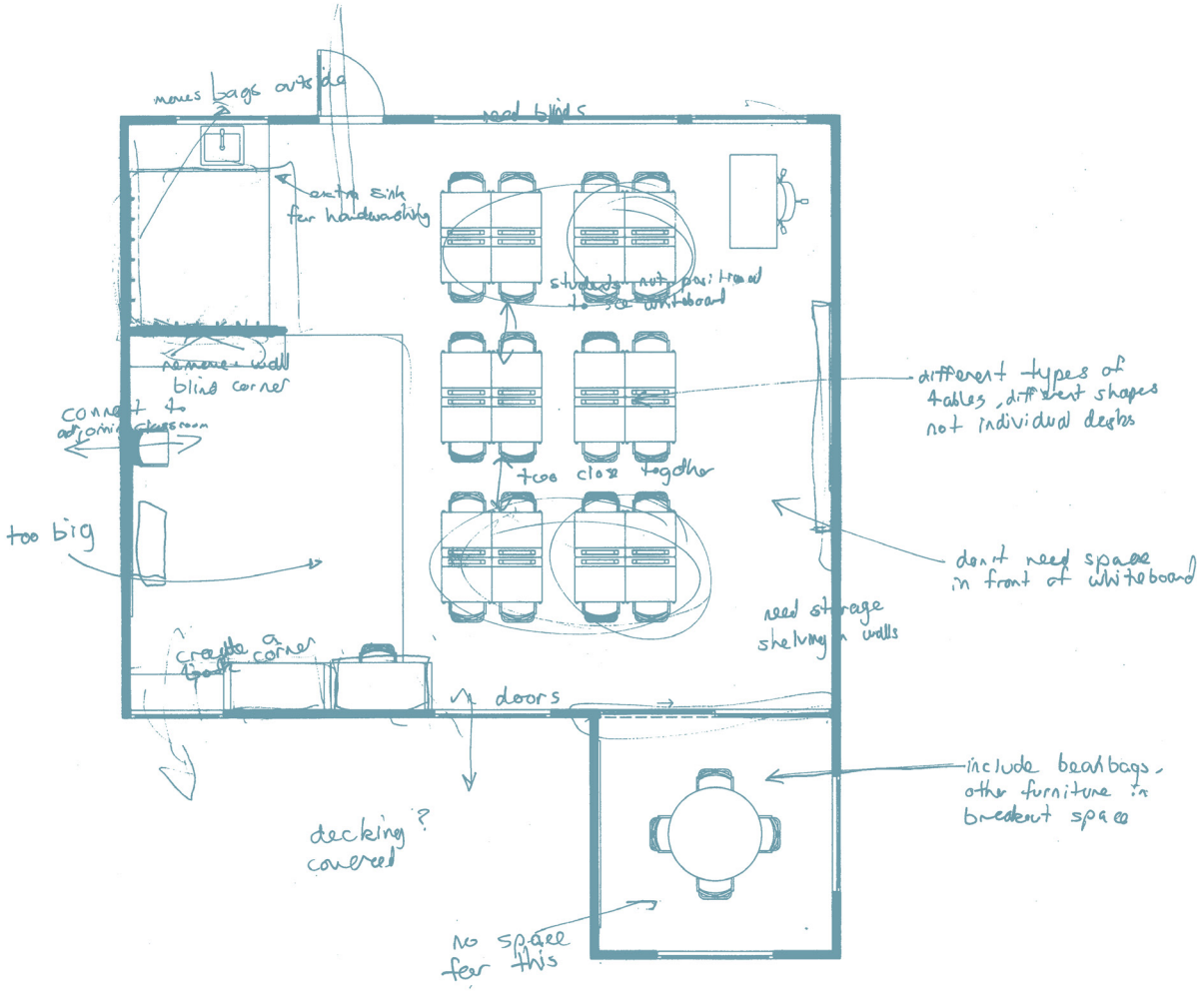


Figure 26. Teachers feedback

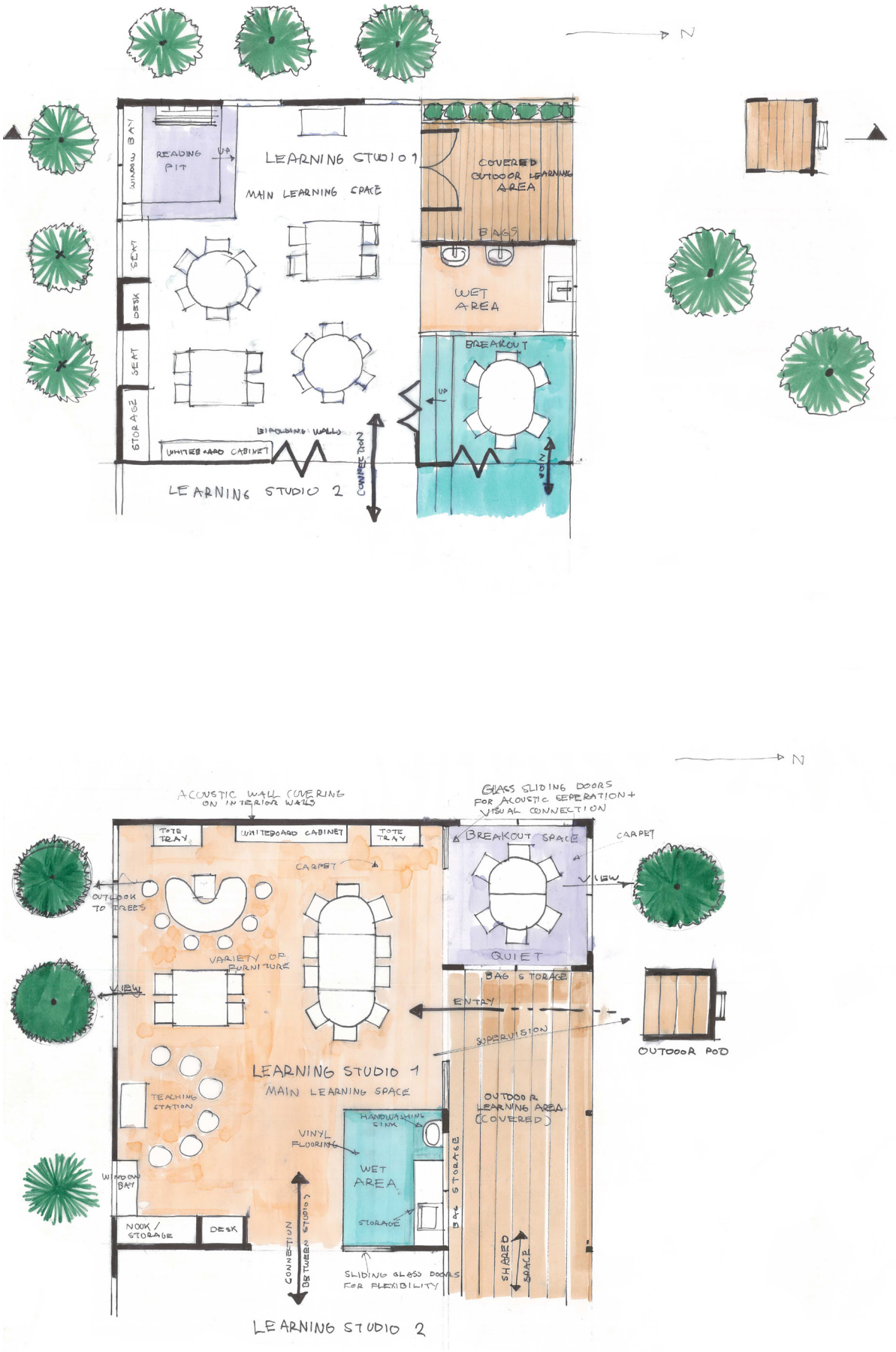
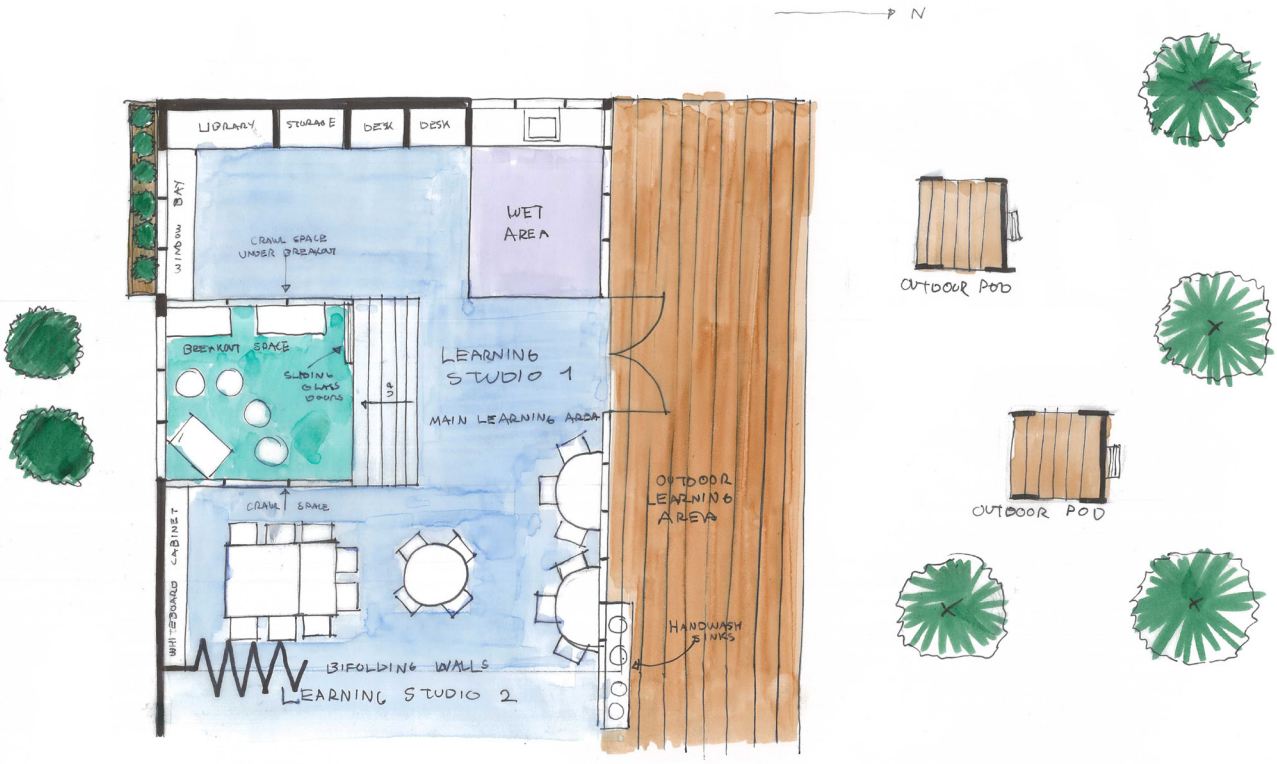
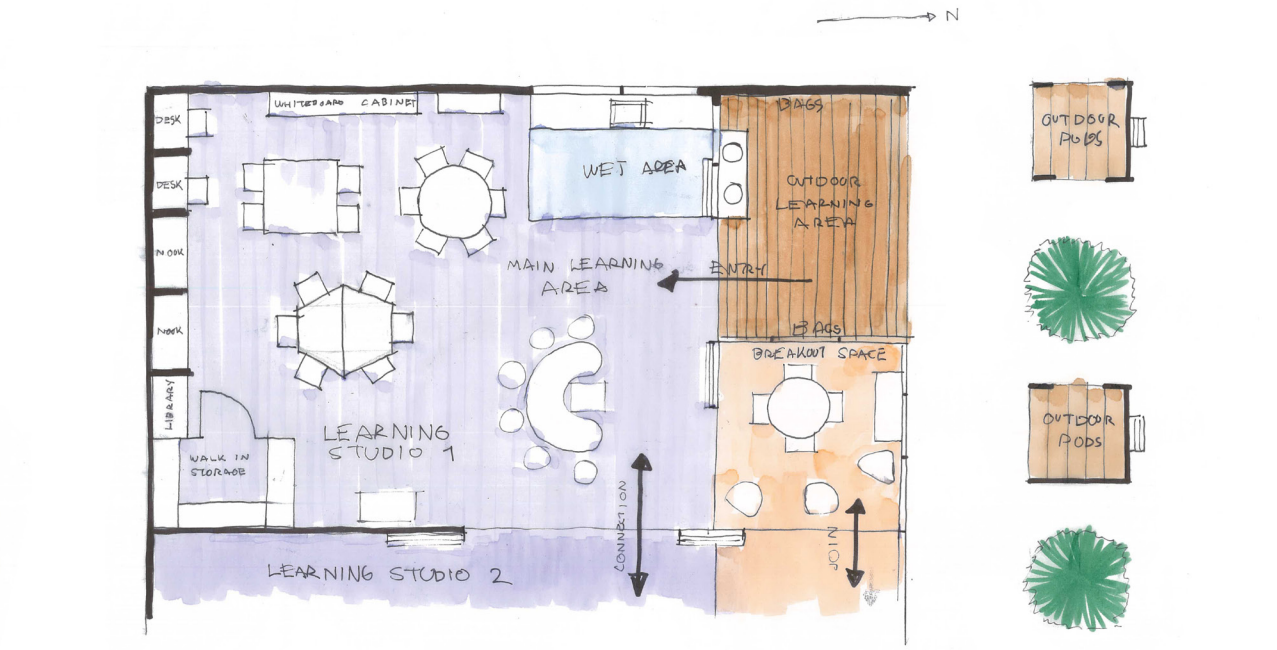


Figure 27. Learning studio concepts


N
LIBRARY
STORAGE
DESK
DESK
WINDOW BAY
CRAWL SPACE UNDER DREAKOUT
WET AREA
BREAKOUT SPACE
SLIDING GLASS DOORS
LEARNING STUDIO 1
MAIN LEARNING AREA
OUTDOOR LEARNING AREA
CRAWL SPACE
WHITEBOARD CABINET
HANDWASH SINKS
BIFOLDING WALLS
LEARNING STUDIO 2
OUTDOOR POD
OUTDOOR POD


N
WHITEBOARD CABINET
DESK
DESK
NOOK
NOOK
LIBRARY
WALK IN STORAGE
WET AREA
BAGS
OUTDOOR LEARNING AREA
MAIN LEARNING AREA
ENTRY
BAGS
BREAKOUT SPACE
LEARNING STUDIO 1
LEARNING STUDIO 2
CONNECTION
JOIN
OUTDOOR PODS
OUTDOOR PODS

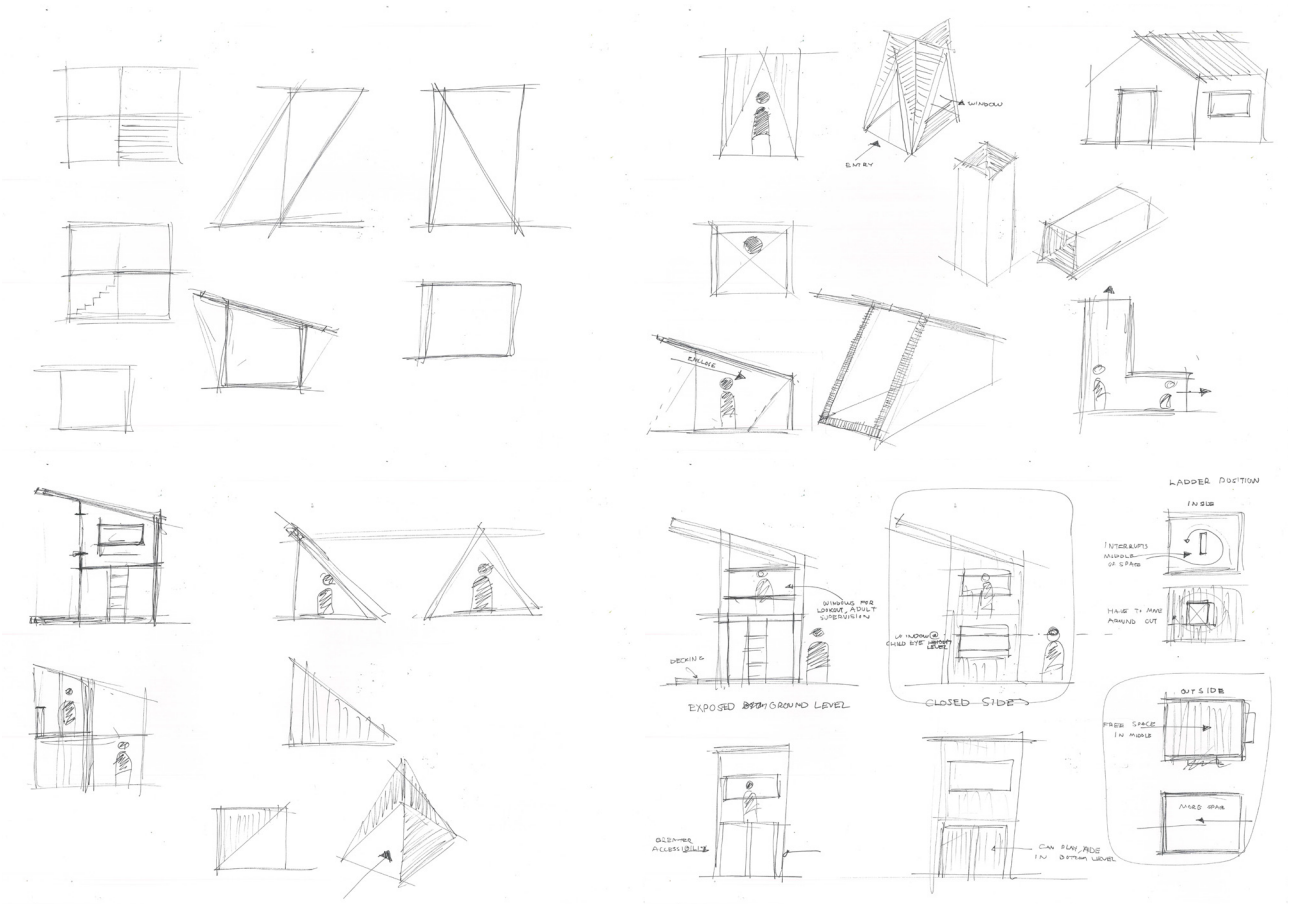
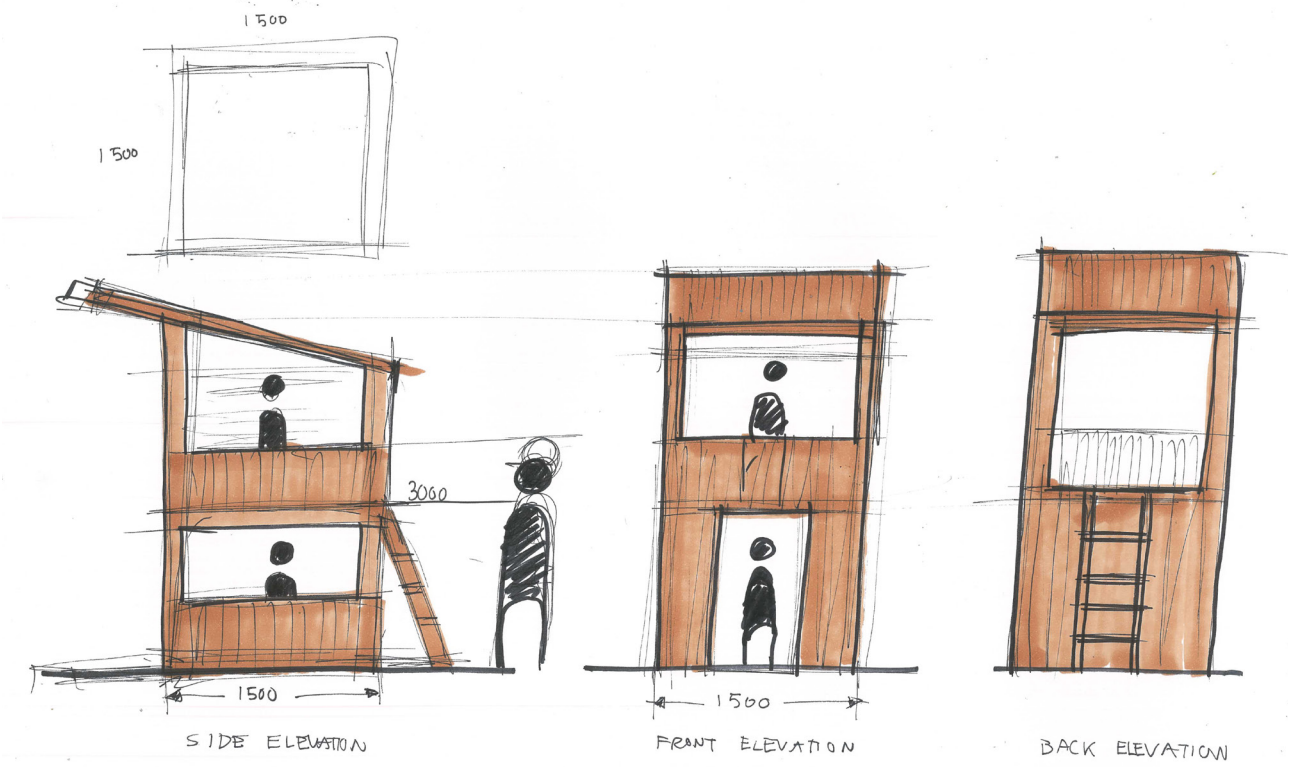


Figure 28. Outdoor pod development


1500
1500
3000
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SIDE ELEVATION
FRONT ELEVATION
BACK ELEVATION

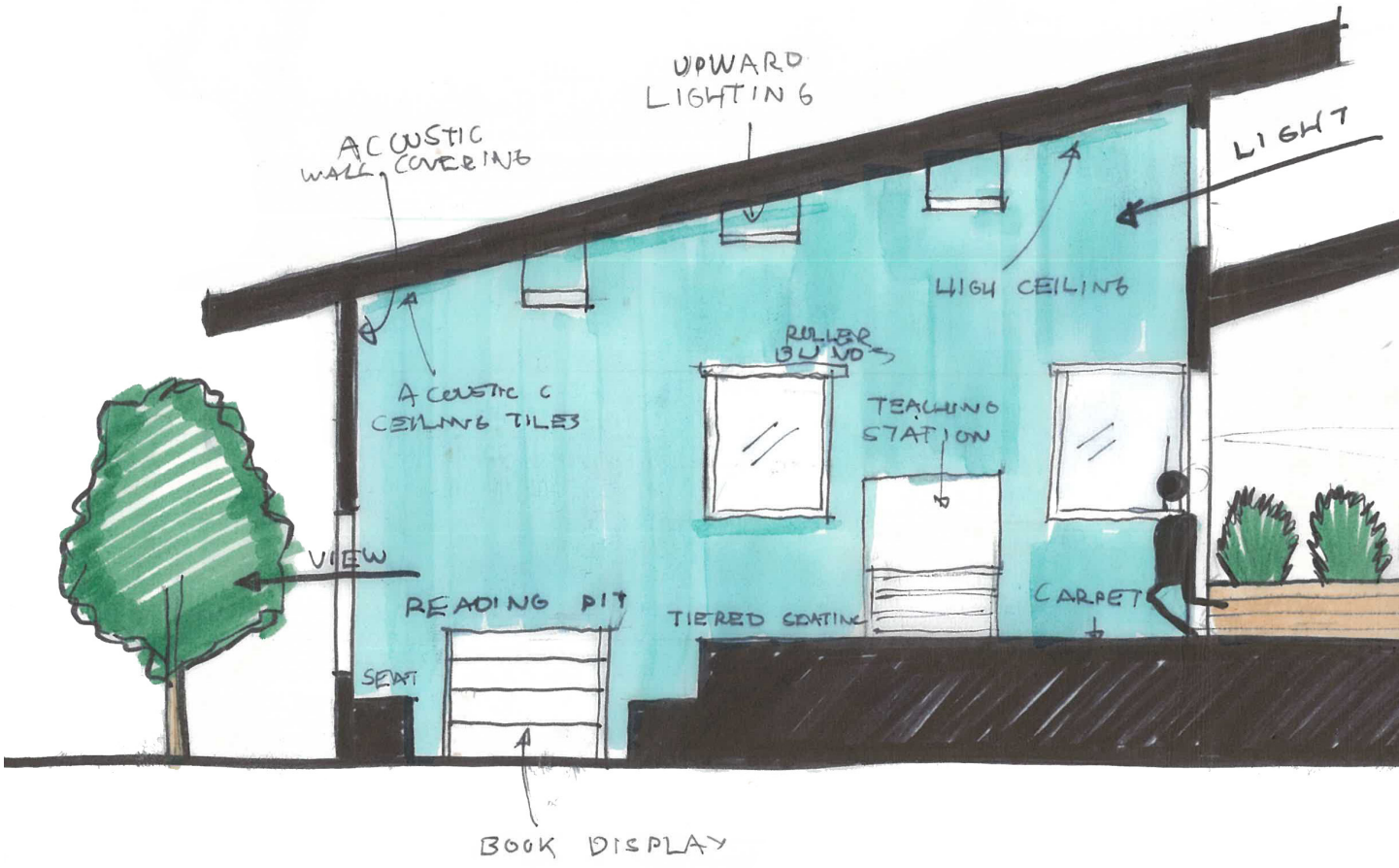
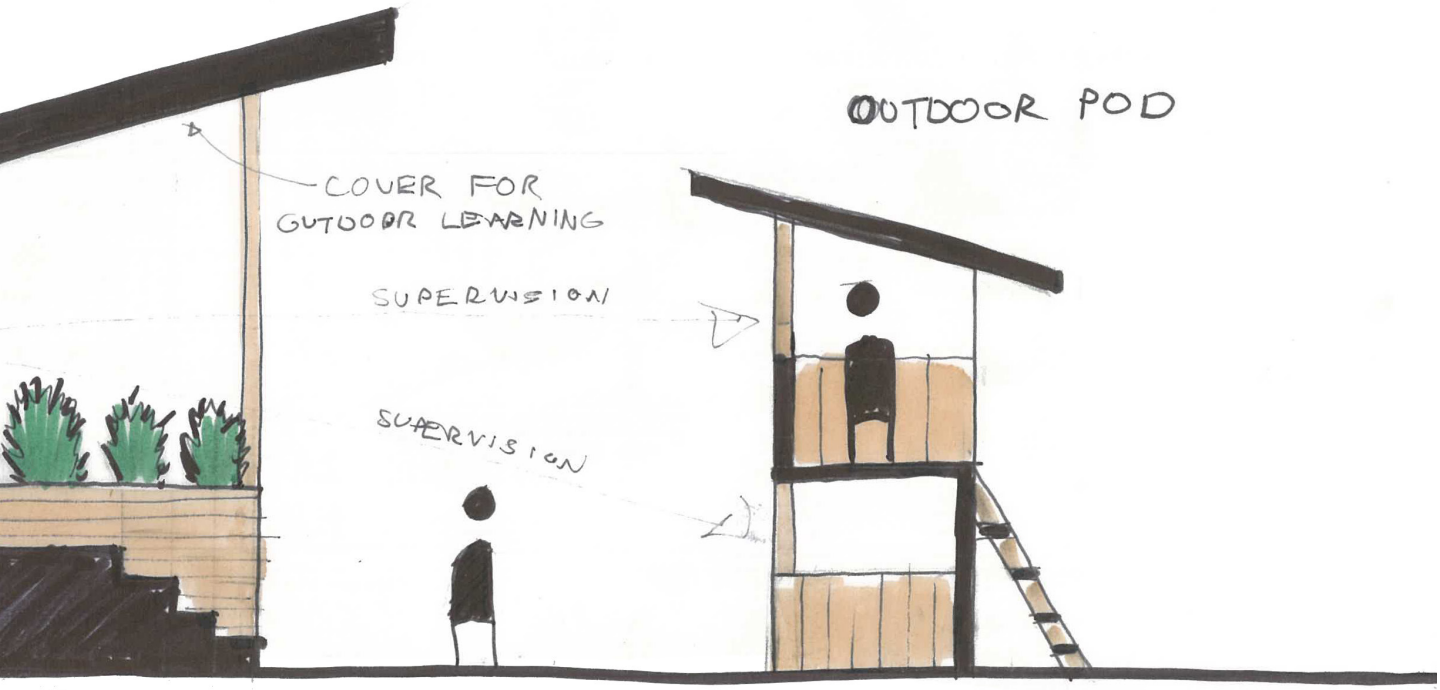


Figure 29. Outdoor pod and learning studio concept


OUTDOOR POD
COVER FOR
OUTDOOR LEARNING
SUPERVISION
SUPERVISION

7.4 Conclusion

The concept design stage was a good test for the design guide. However, because of the design's conceptual nature, not all the principles were investigated in detail. Additionally, the small context of a single learning space meant that not all the design principles could be tested. A developed design would be needed to test all the design recommendations thoroughly.

The learning studio design proved to be a successful combination of a single cell classroom's small volume and the various spaces in a flexible learning environment.

It was a challenge having to consider the needs of the teachers and the other students amongst the needs of autistic students. There were some conflicts between the groups, such as autistic students wanting a small learning space and teachers wishing to open their learning space to an adjoining one. Autistic students also want sameness in their environment, while having an adjoining learning environment may create changes in their surroundings. The concept designs achieve a compromise by allowing the studios' flexibility to open or close off to each other.

The outdoor pods were a successful design because they reduce the design guide to its purest form.

Some improvements could be incorporated into the developed design stage. The design needed the constraints of a location to be more realistic. The designs should be wheelchair accessible to accommodate students with mobility difficulties. The change of levels was heavily relied on to distinguish spaces within the studios; therefore, other methods should be explored. There was little consideration of materials in the concepts. Again, a developed design would offer the opportunity to explore autism-friendly materials.

Developed Design

8

8.1 Introduction

Following feedback from the concept design stage, it was decided that a more complex design brief would be helpful. Creating a new primary school in a real location would allow more recommendations to be incorporated and test the guide with a more realistic design.

8.2 Brief

The brief was to create a masterplan for a new contributing primary school (years 1-6) that would cater to the growing student population in Wellington city. The total development needed to include learning spaces for 400 students and would be split into two stages. Stage one of construction would provide infrastructure suitable for 400 students and 624m2 of learning spaces for 200 students. Stage two would provide an additional 624m2 of learning spaces for a total of 400 students.

The following spaces are required:

- Learning spaces (total gross floor area of 1248m²)
- Library (total gross floor area of 90m²)
- Administration area (total gross floor area of 200m²)
- Multi-purpose hall (total gross floor area of 200m²)
- Adventure playground
- Sports field (3000 m²)
- Two hard courts (750 m² each)

The minimum site area of 1.56 hectares was based on the MoE's site size guideline of 14m² per student + 1 hectare for primary schools, used for considering sites to buy for new schools. The Ministry states that this is a guide, not an entitlement and that many schools can operate on smaller sites (MoE, 2020a).

Nearby Amesbury School, which also has 400 students (McKenzie Higham Architects, 2019), has a site area of approximately 2.75 hectares. The benefit of a larger site such as Amesbury School is additional space for programmes such as sports fields and car parking.

8.3 Site selection

The location for the new primary school was confined to Wellington city for ease of site visits. The site selection was based on areas of growth in the city. According to the National Education Growth Plan in 2019, Wellington North's population is expected to increase significantly. The site is popular with families, attracted by the medium density housing close to Wellington central (MoE, 2019, p.1). Development planned in the Grenada/ Newlands area on greenfield sites will result in a potential 3,500 new dwellings (MoE, 2019, p.2).

To accommodate the increase of students in the area, the Ministry plans to build at least one new primary school at an unconfirmed time (MoE, 2019, p. 1).

The Grenada Village/ Paparangi/ Woodridge/ Horokiwi area is expected to grow extensively within the Wellington North catchment. Between 2020 and 2043, the area's population is forecast to grow from 6,658 to 10,503, a 57.75% increase (informed decisions, 2020b). An additional 347 primary

schoolers (children aged 5-11) will reside in the area by 2043 (informed decisions, 2020a).

Two large greenfield sites in the Newlands/ Grenada area are anticipated to make up the bulk of new dwellings in the area.

Woodridge is a new residential suburb on the site of Woodridge Farm. Over 500 homes have been built in Woodridge by developers Wrightway Homes, with plans for a further 500 properties (Woodridge Homes, n.d.).

Grenada Hunters Hill, located directly north of Woodridge, is a planned subdivision on the 400-hectare site of Lincolnshire Farm. Over the next 15 years, the proposed development includes 800 – 900 new dwellings, a business area, new road connections, and a 4-lane link road connecting State Highway to State Highway 2 (Russell Properties, n.d.).

Several smaller developments are also being planned in the area with the potential for a further 1,300 new dwellings (MoE, 2019, p.1).

According to the MoE, there has been an increase of 707 students since 2014 in the Wellington North catchment, with the network currently operating at 98% capacity. (MoE, 2019, p.1).

Because of the expected population growth in the area, especially families, the Grenada/ Woodridge area is the most suitable area for a new primary school in Wellington North. It also contains many possible vacant sites for a new school to be established.

The site selection started by investigating the development plans for both Woodridge and Grenada Hunters Hill. The criteria for selecting potential sites were the following:

- locations with a minimum area of 1.56 hectares
- none or few existing structures
- designated for development

Only Grenada Hunters Hill had suitable sites that met these criteria. The final site was chosen based on having a relatively lower wind zone, useful transport links and a central location to future housing developments.

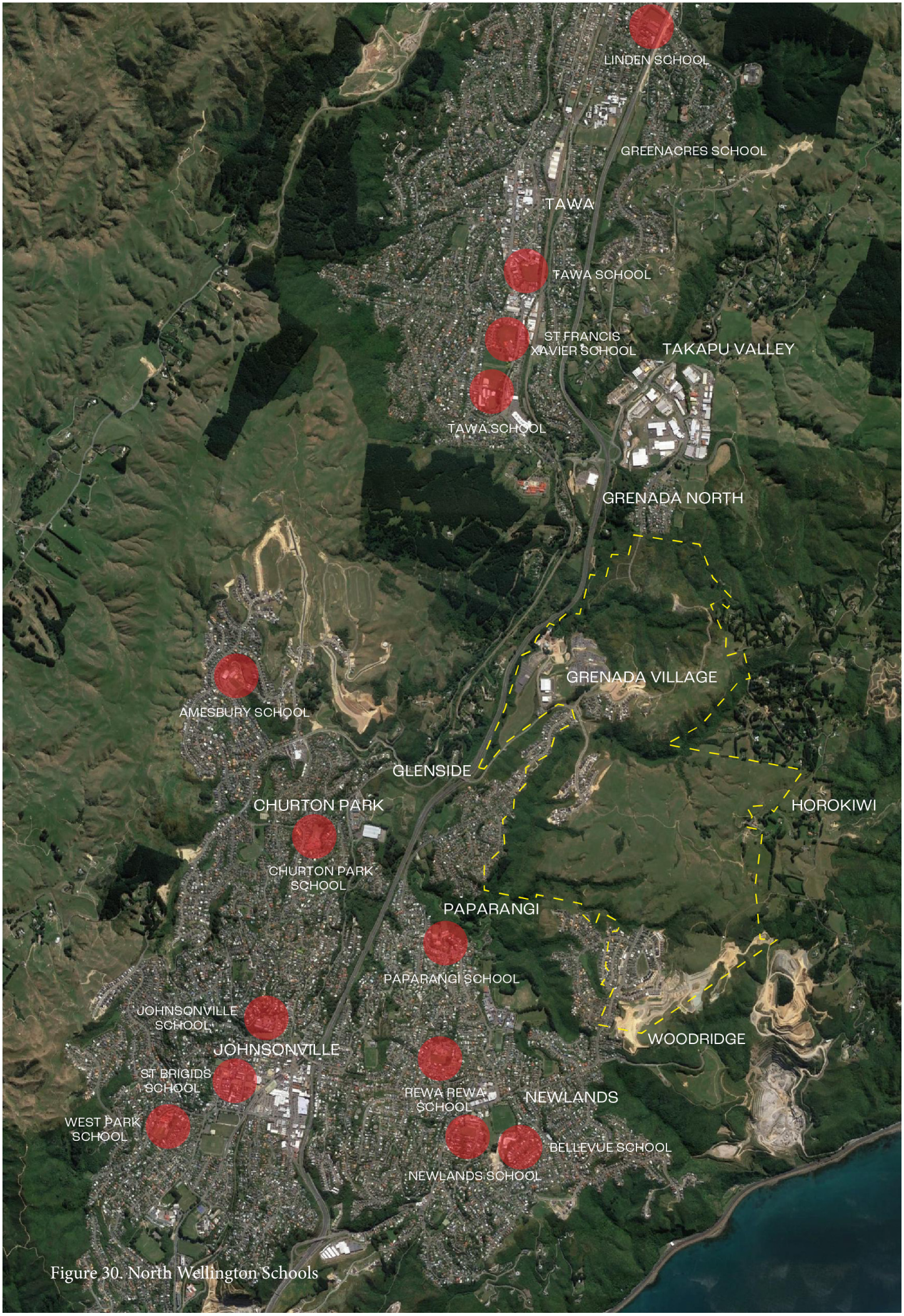


Figure 30. North Wellington Schools

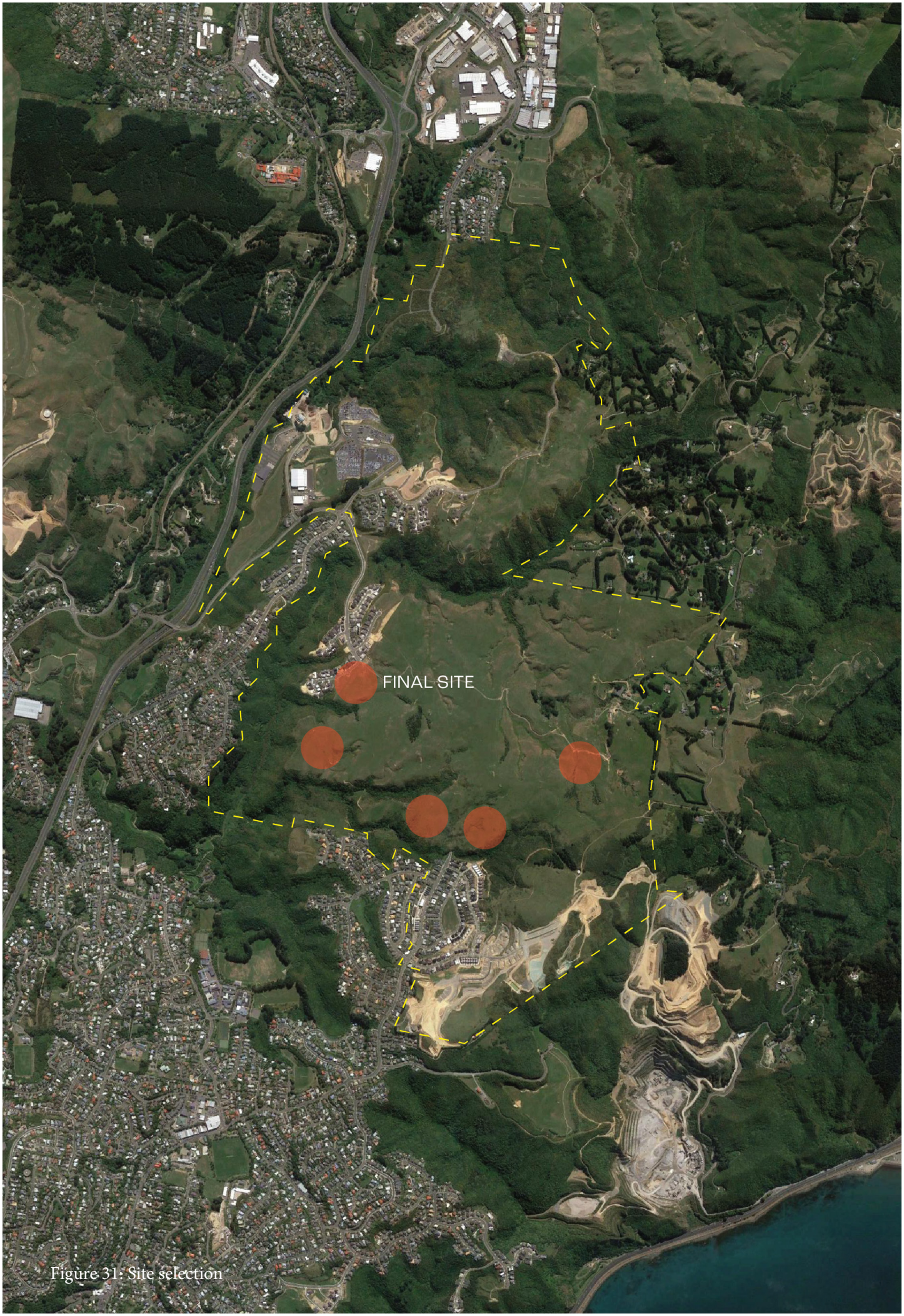


Figure 31: Site selection

8.4 Site analysis

The site, covering approximately 2.25 hectares, is located in an area designated for housing (WCC, 2006, p.33). The school is bordered by Trelawny Terrace, an existing local road, and an extension of Grenada Drive, an avenue that acts as the 'main street' of the development. Grenada Drive provides "the backbone of the movement network in the structure plan area, including the main public transport routes. This would connect directly onto the Link Road and also connect with the extended Woodridge Drive" (WCC, 2006, p.13).

Several dwellings have been built on Trelawny Terrace, mainly on the north side opposite the school site. A protected reserve area borders the south side of the site. An employment area offering "a high level of amenity for non-retail commercial uses" is planned for on the opposite side of Grenada Drive.

Because the site is currently designated for housing, the Grenada Hunters Hill development will have a reduced housing amount. However, this project proposes that a primary school in the area will be attractive to new families and provides an essential service for the community.

A site visit was conducted to gather imagery and information from the site. At the time of the visit, the land was being used for horse jumping. This demonstrates the ruralness of the area, which will soon become suburban. The site was mainly clear except for some areas of bushes. The topography was the most striking feature of the site. A small section is flat, but most of the land consists of rolling hills. The site's higher points have panoramic views of the Grenada area and the northern hills further out. All the surrounding housing was new, illustrating the recent establishment of the area. The juxtaposition between suburban and rural settings was also prominent.

A further site analysis was conducted, investigating sun, wind, zoning, transport, and topography.

Grenada Drive

Corner Grenada Drive & Trelawny Terrace

Figure 32. Site photos

Grenada Drive future extension

Trelawny Terrace

The Site

Figure 33. Site boundary

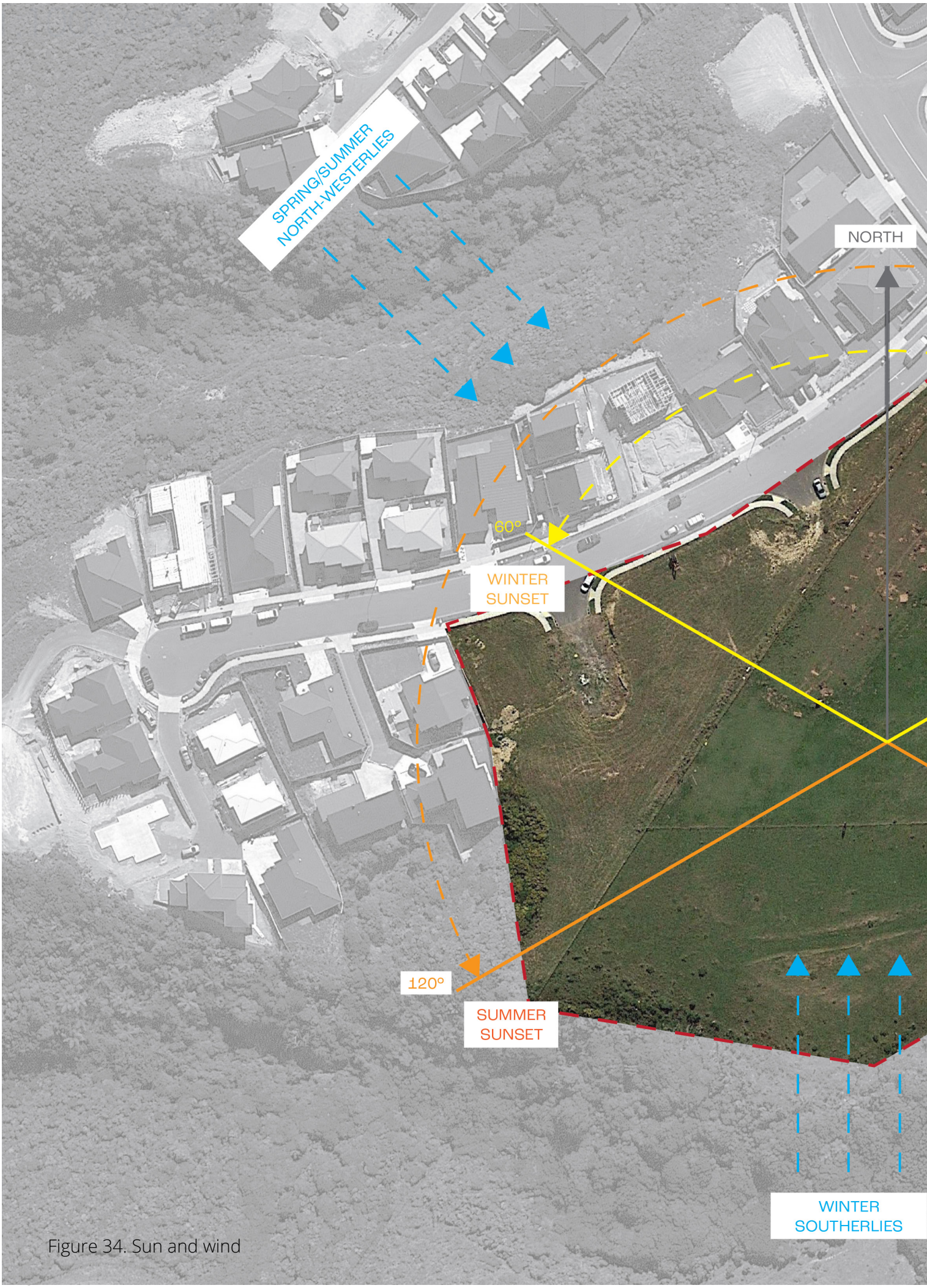


Figure 34. Sun and wind


60°
WINTER
SUNRISE
120°
SUMMER
SUNRISE

Figure 35. Future zoning

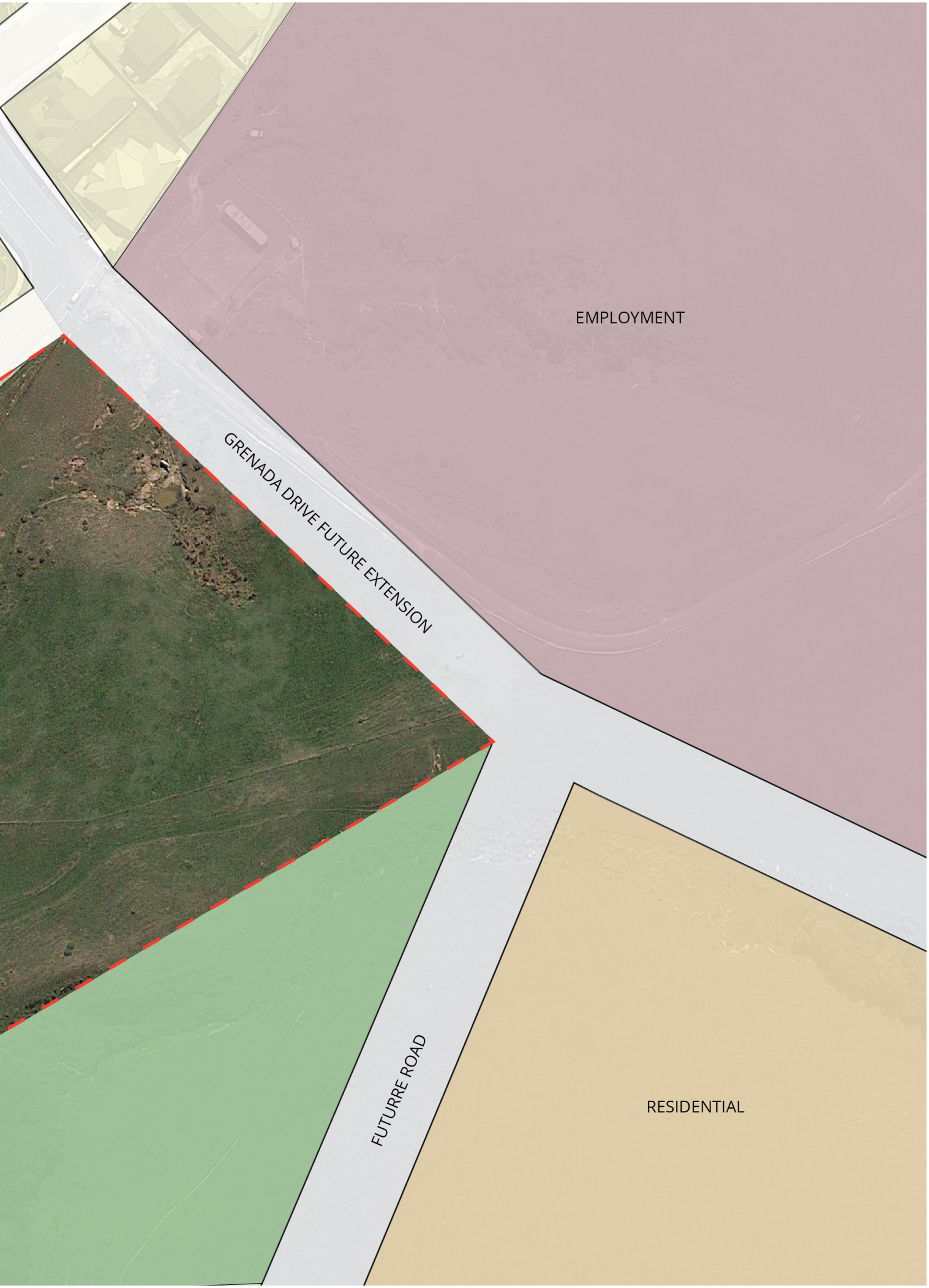

EMPLOYMENT
GRENADA DRIVE FUTURE EXTENSION
FUTURRE ROAD
RESIDENTIAL

Figure 36. Circulation


PEDESTRIAN
VEHICULAR
PUBLIC TRANSPORT

8.5 Design process

A masterplan of the school and plans for the learning suites and outdoor learning spaces were developed as part of the final design. It was decided that only the learning spaces needed to be developed since they were the focus of this research and of the design guide.

The choice of each building element (flooring, walls, roof, ceiling, cladding, windows, doors) was based on a holistic consideration of criteria. Recommendations from the design guide and the documents in the DQLS series formed part of this criteria. Considerations for autistic students, such as acoustics, colour, and texture, were factored in each component's decision-making process. Other factors such as sustainability, durability and maintenance were also included.

Hand drawing was initially used for the developed design stage before the design was translated into a digital model. The design was then developed with the digital model and hand drawing in unison. For example, the studio interior's viewpoints from the digital model were used in hand drawings to explore the interior design. Precedents of new educational facilities were used for inspiration of the interior spaces. Site visits to schools in Wellington with new learning spaces were also conducted to gain further impressions of modern learning spaces in NZ.

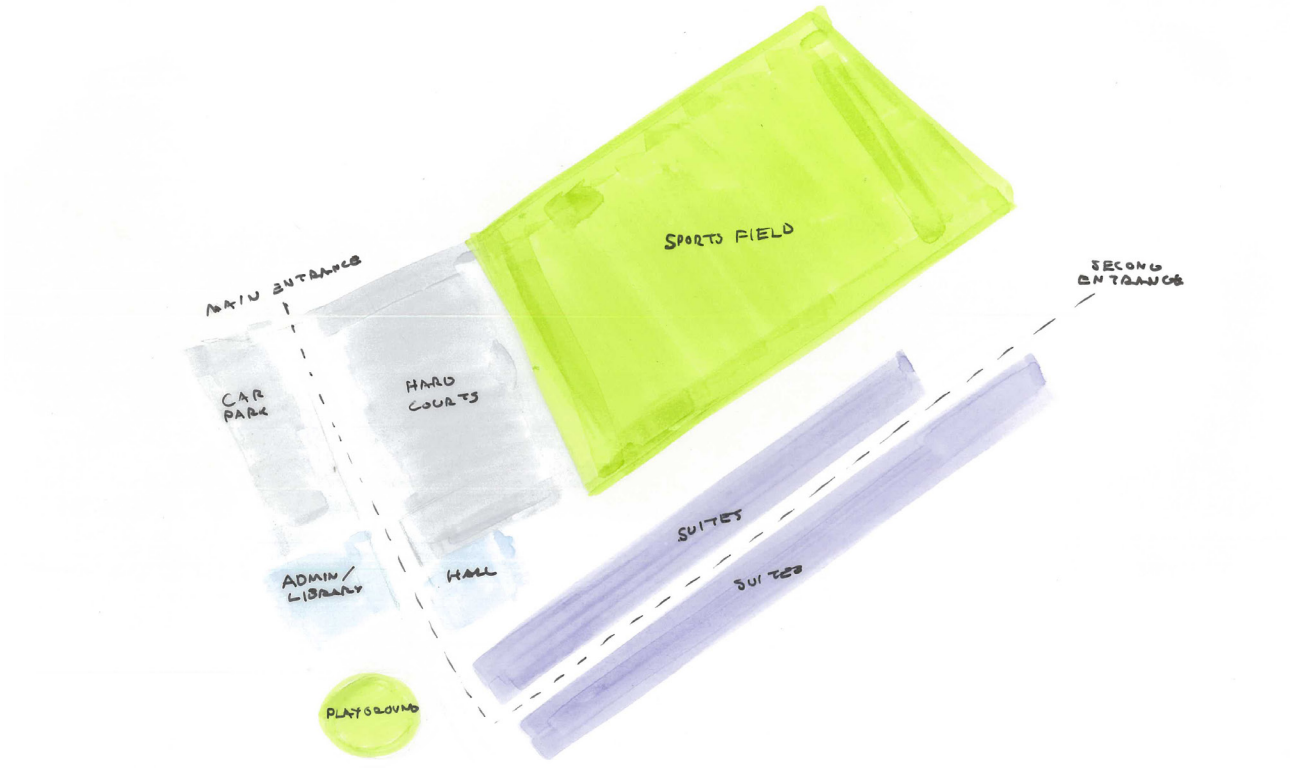


Figure 37. Masterplan final concept drawing

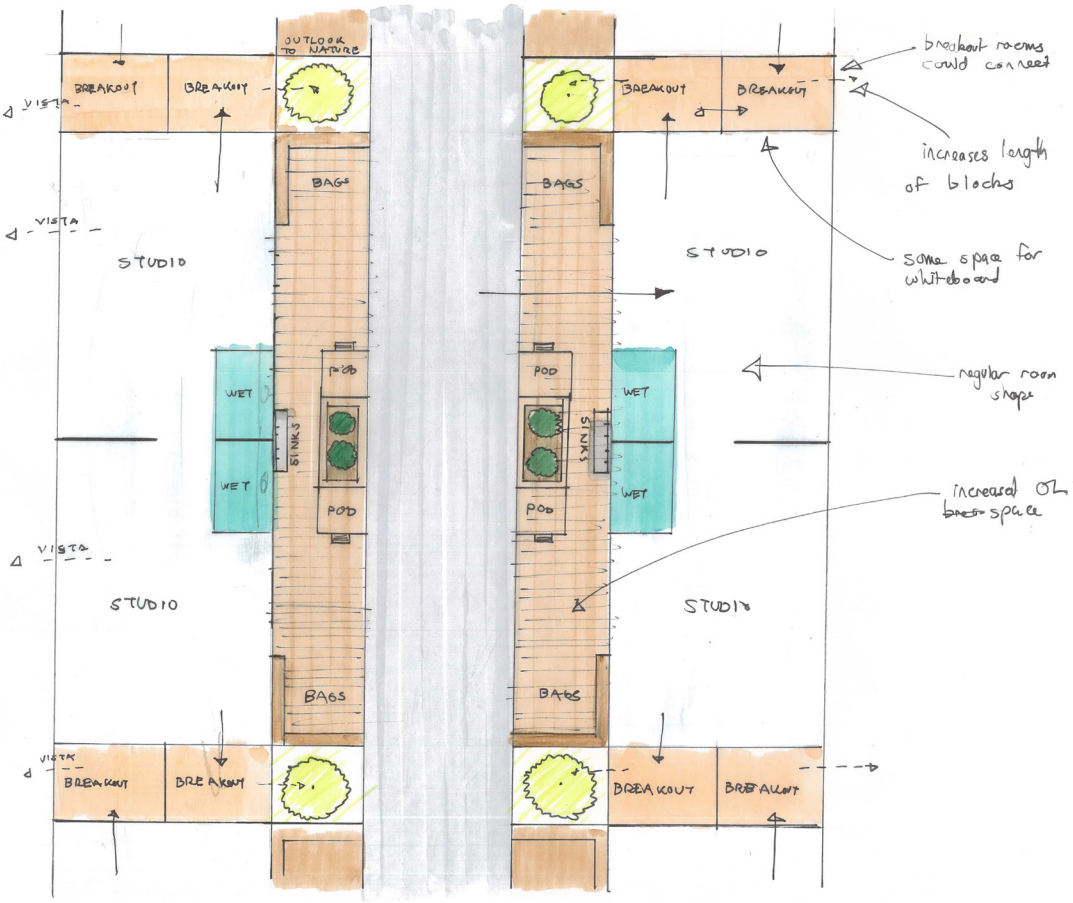


Figure 38. Learning suite and outdoor space development drawing

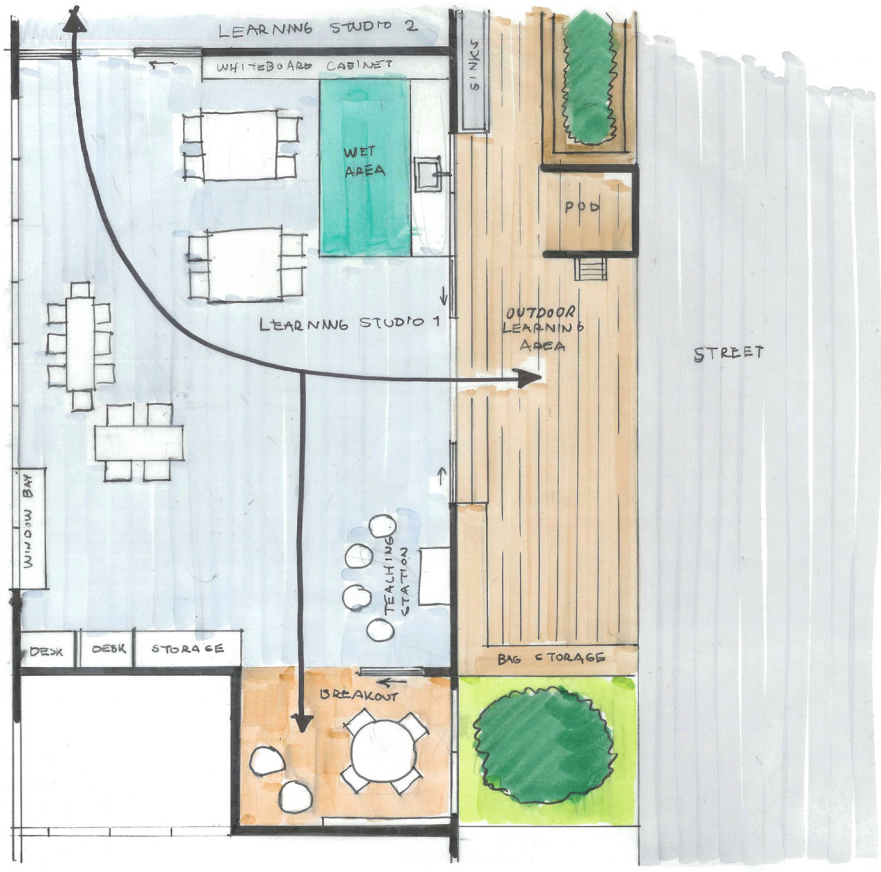


Figure 39. Learning studio drawing

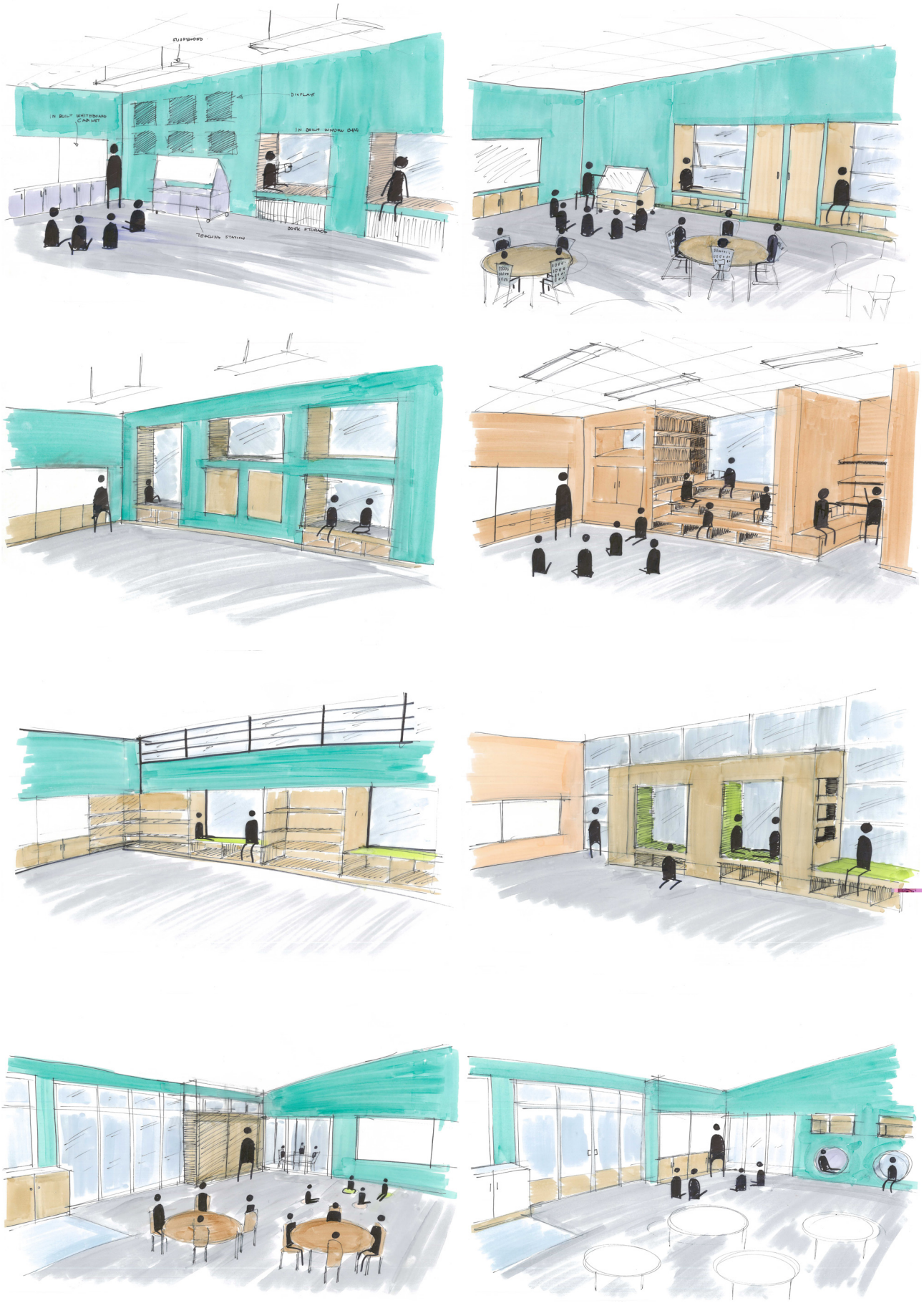


Figure 40. Learning studio interior concept drawings

Figure 41. Learning studio interior drawing

8.6 Developed design

From the outset, it was decided that to design an entire school was outside the scope of this research, the focus of which has been the learning spaces or classrooms within a school. In working on the developed design for the learning spaces, it was considered helpful to master plan a 'typical' primary school, purely to give a sense of context.

The school's main entrance is located on Trelawny Terrace, providing access to the car park. The administration building, library and multi-purpose hall have been positioned adjacent to the car park for vehicular access.
The topography was a dominant influence of the overall masterplan. The sports field and hard courts have been located on the flat part of the site along Trelawny Terrace, while the remaining programmes have been positioned around the remainder of the site. The design consists of a 'learning street' running between two rows of learning studios. The street acts as the school's central spine by connecting all the learning studios, providing good orientation for students, and strengthening the relationship between the spaces. Trees and shade sails have been included in the learning street. Trees are provided for shade, connection to nature, and for play. The blocks follow a curved path working with the contours of the site. Because the studios and the learning street are located on a slope, cutting and filling are required to achieve a level elevation. The lower 'slope' forms a viewing area for the sports fields, and the upper 'slope' forms a series of raised vegetable and flower gardens, which will be an important 'learning' space for students.

Key features from the concept stage have been carried into the design of the learning spaces. All the learning studios have a wet area, breakout room and covered outdoor learning deck. Each studio also connects to an adjacent studio through either sliding glass doors or by sharing an outdoor courtyard. This connected design between studios creates a sense of a learning 'village'.

Each studio's floor area aligns with the MoE's average room size of 78m2 for regular teaching spaces for primary schools (MoE, 2020e).

Autistic students have a variety of spaces to work in when the main learning space becomes too overwhelming. The breakout rooms provide a comfortable, quiet space inside the studio, while the outdoor deck or pods offer nearby locations for outdoor study.

The desire for sameness in the environment from autistic children has been factored in the studios' design. The one class unit size means minimal changes in the environment, except when two classes may want to collaborate and share spaces. Most storage units and structures such as the pods are fixed, meaning their location will not change and trigger students anxiety. Flexibility for teachers and students to move around seats and tables is offered. Relocatable tiered seating is included in the courtyards, offering study and presentation spaces for students.

For protection from the prevailing northwesterly and southerly winds (Maclean, 2015), all the outdoor learning spaces have been positioned inward to face the learning street. The roof eaves facing the learning street have a matching height to reinforce the strong relationship between the spaces. The northern faces of all learning studios are taller to maximise the surface available for glazing.

The outdoor pods have been incorporated into the outdoor learning decks, which

creates a more unified design. The elevation of the roofs is tall enough to allow sufficient height clearance. The outdoor learning decks also include bag storage, sinks and areas of planting. The learning decks and courtyards are shaded to protect students from harsh sunlight.

Each space has distinct colours and materials to assist autistic students in sensory wayfinding. Natural materials have been incorporated throughout the design to provide a calming environment for students. LED lighting has been incorporated into the design, which benefits autistic students due to its calming light temperature and lack of flickering (Bell, 2020). All lighting is controllable and locally dimmable, and task lighting is also available for increased illuminance.

Please refer to Appendix 4 for drawings of the developed design.

Typical learning studio

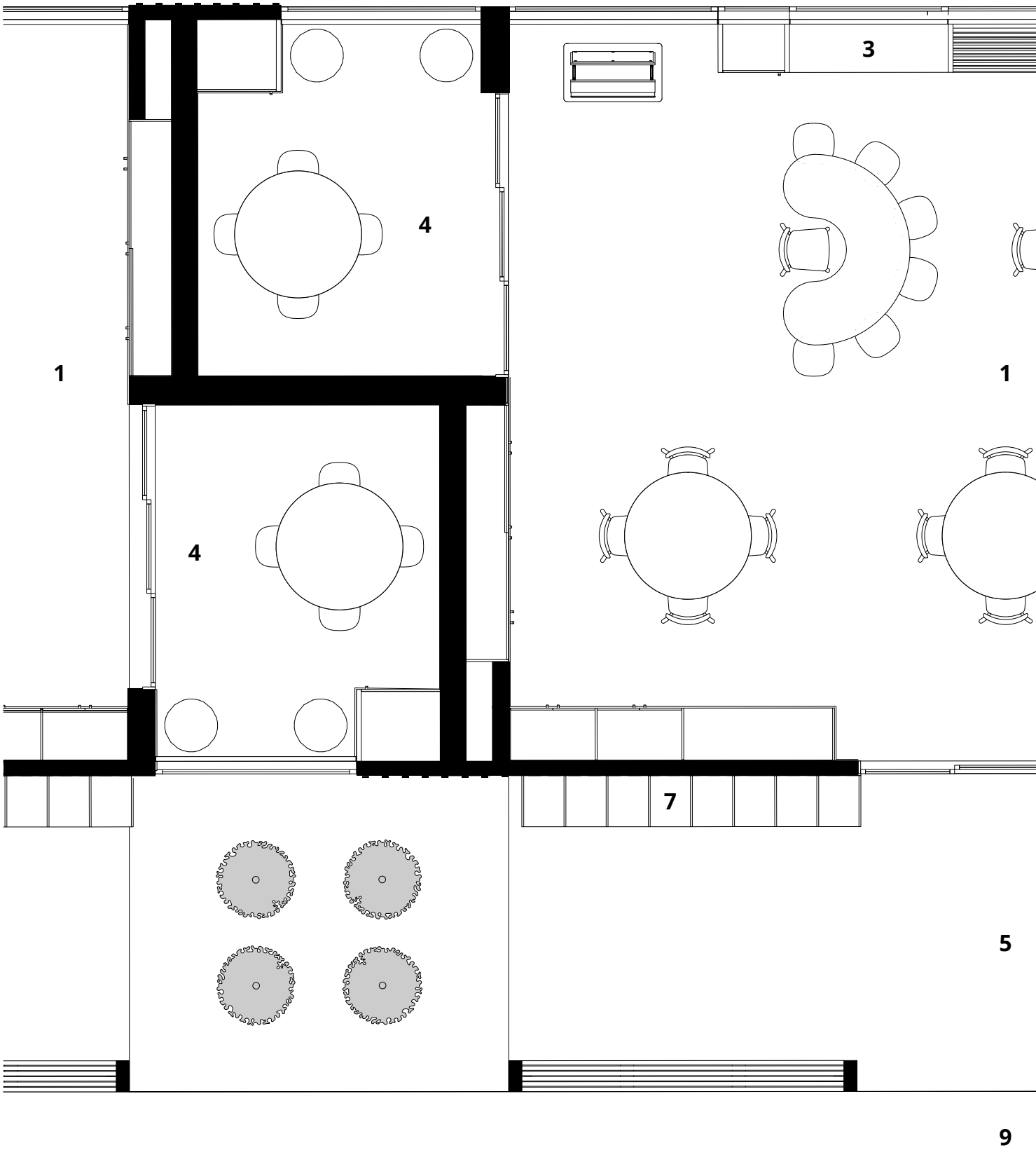
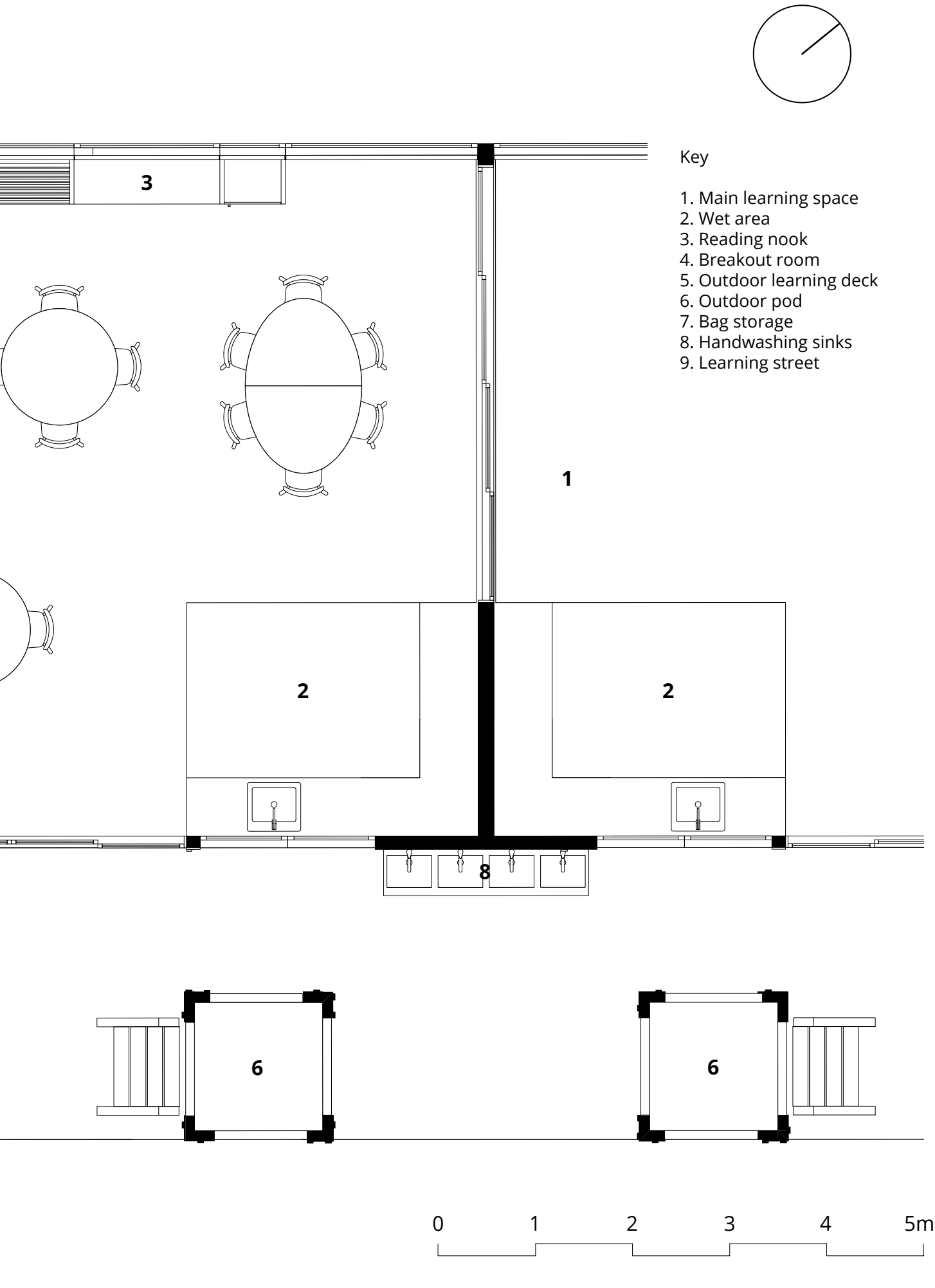


Figure 42. Plan of typical learning studio


Key
1. Main learning space
2. Wet area
3. Reading nook
4. Breakout room
5. Outdoor learning deck
6. Outdoor pod
7. Bag storage
8. Handwashing sinks
9. Learning street
3
1
2
2
8
6
6
0
1
2
3
4
5m

Learning street entry

Figure 43. Render of learning street entry

Learning street

Figure 44. Render of learning street

Learning studio

Figure 45. Render of learning studio interior

Learning studio

Figure 46. Render of learning studio interior


Maisy's Bus
Little Drivers
Relax

Breakout room

Figure 47. Render of breakout room


sound spelling patterns

Breakout room

Figure 48. Render of breakout room


11

Courtyard tiered seating

Figure 49. Render of tiered seating in an outdoor courtyard

Veggie garden

Figure 50. Render of the vegetable garden

Outdoor pod

Figure 51. Render of an outdoor pod interior

Outdoor pod

Figure 52. Render of an outdoor pod interior

8.7 Reflection

The developed design stage provided the most help in testing the design guide. More recommendations were factored into the guide following this stage, and the outdoor space category was utilised for the first time. Breaking the design down into elements and using the design guide to inform the decision-making process helped design the learning spaces. Most of the recommendations were simple to implement and mainly involved thoughtful design rather than adding additional costs to the build. The recommendations in the DQLS series were extremely valuable in adhering to the design guide and ensuring the learning environment would be tolerable for students on the spectrum. Because the guide isn't overly prescriptive, it allows the designer to impart their preferred style in the design.

As in the concept design stage, compromises were made to satisfy the needs of students on the spectrum with the requirements for modern learning. The one class units were retained, while flexibility to combine or separate classes is provided with sliding doors and the outdoor courtyards. Fortunately, having various learning spaces (e.g. breakout rooms, wet areas, outdoor learning decks) bodes well for both parties.

The developed design succeeded in translating the design guide into a fully realised design. Multiple design features, e.g., reading nook, outdoor pods, vegetable garden, were included to make the space comfortable for students on the spectrum. The design provides a range of calm learning spaces for autistic students to work in. Although the learning studio design involves more internal walls than an open plan learning environment, this research advocates for smaller learnings spaces to benefit autistic students.

Acoustics, furniture, and finishes were a significant focus in the design. If more timing had allowed, lighting options and circulation could have been more thoroughly investigated.

Only one example of a learning studio setup was devised. Further development of the design could have allowed additional arrangements to be designed, which could have shown the transition from the junior, middle, and senior syndicates and the overall progression to a more neurotypical setting.

8.8 Evaluation

The developed design will be evaluated here against the design guide to determine its successes and failures.

Space

The decision to limit learning spaces to 25 students using the learning studio model helped achieve several spatial recommendations. A small and simplistic layout was created, which bodes well with the preferences of autistic students. Large spaces were avoided. A distinction of learning spaces was evident in the breakout rooms and wet areas with different flooring and wall coverings.

Having a change in height was easy to achieve and created a more spacious atmosphere in the studios. The outdoor learning decks were an effective method of creating a threshold space between inside and outside the learning studios. They were also successful in housing bag storage and increasing the amount of working space for students. Multiple workspaces were developed with the inclusion of breakout rooms, outdoor learning decks and courtyards. Hideaway spaces were achieved through the creation of the outdoor pods, as well as

the breakout rooms. Using curved walls was a well-intentioned idea but not practical for furniture placement.

Circulation

The school's design negated the need for corridors, so several circulation recommendations were not tested. Circulation within the learning studios proved challenging to plan due to the limited floor space. This would be a good area for further investigation.

Connecting all the studios to the same street makes locating the studios straightforward. Travelling between studios is also convenient, although in wet and cold weather this may not be ideal. The sloped site presented some circulation issues. The distance from the primary school entrance to the learning studios is quite long because of the ramp connecting the areas.

Sensory

A variety of learning environments have been achieved by including breakout rooms, outdoor learning spaces, and pods. This should provide autistic students with several good options for workspaces.

The breakout rooms and outdoor pods functioned as quiet/safe spaces.

The recommendation advising learning environments to be calm, ordered, and low stimulus contradicted the advice on creating a balance between calm and stimulating.

The small scale of the learning studios helps achieve a sense of calmness not possible in a large learning environment.

The furniture layout in the learning studios was designed to be simple and orderly.

The colours in the breakout rooms were purposefully chosen to provide some visual stimulation. The use of grey wall coverings in the main learning space, while calming, could prove too under stimulating for some students. The use of white was kept to a minimum to limit under-stimulation.

Climbing opportunities in the outdoor pods provide some stimulation for students. More opportunities for stimulation, such as climbing walls, could have been included.

Having a calm environment relies on teachers putting artwork and decorations in the designated spaces. This might prove too restrictive, and an abundance of visual elements could become too overwhelming.

Indoor environmental quality

The MoE's mandatory requirements for learning environments made several design guide recommendations easy to achieve.

Regarding lighting, the requirement for daylighting to be the primary source of lighting in schools (MoE, 2020c, p.13) means the learning studios have plentiful natural light. The requirement for luminaires to be 100% based on LED lamp technology (MoE, 2020c, p.22) means that flickering is not an issue. The requirement for controls/switching (MoE, 2020c, p.21) also satisfies the controllable lighting recommendation.

Regarding acoustics, the Ministry have mandatory sound insulation and impact insulation requirements for internal walls, doors, windows and openings. These regulations help achieve the design guide recommendations for quality acoustics and including sound insulation between rooms. The ceilings, wall coverings and carpet also help achieve quality acoustics.

The design of windows and doors in the learning studios was complex. The design guide recommendations advising against multiple doors and windows contradict the need for ventilation and natural light. Additionally, while an external view is distracting for some students, it is also desirable for many students and teachers. High-level glazing was included in the studio but was also supplemented with low-level glazing. Glazing was provided on two sides of each learning studio, with the option to block out distractions with sunscreen roller blinds if necessary.

Finishes

The acoustic requirements for the indoor learning spaces dictated the finishes used. However, it proved easy to find materials with natural textures and subdued colours. The acoustic wall coverings and carpet shades in the breakout rooms closely matched the autism-friendly colours recommended by GA Architects. The colours in the main learning space were also chosen for their calm appearance. Natural timber was used in most of the furniture and cladding of the learning spaces. Timber ceiling tiles with the necessary NRC value were also included in the design.
Visual contrast and texture were achieved through different wall coverings and flooring within the learning studios. The outdoor learning spaces also had a distinct material palette to differentiate them from the indoor learning spaces.

Furniture

Multiple comfortable pieces of furniture have been developed in the design, such as the window bays and breakout spaces. All furniture included in the design is repositionable.

The majority of storage spaces in the learning studios are concealed to satisfy the recommendation for closed storage. Limited amounts of open storage were included for easy access to trays and supplies. There is some variety of furniture in the studios, including chairs, stools, and window bays. Some additional furniture options could have been included.

Outdoor space

The design of the outdoor spaces was equally detailed. The outdoor learning decks provided additional areas for autistic students to work and play in. Shared courtyards were developed between studios to allow for small scale interactions. Both these spaces have been covered with a roof. The street created an area for students to play in and be surrounded by nature.

8.9 Developed design guide

Based on the application in the developed design, the design guide was edited to become a more workable resource. Contradictory recommendations were edited, and irrelevant recommendations were removed. Some recommendations were expanded to provide additional assistance to architects. Additions to the booklet were made to make the resource more useful.

The autism summary section from the teachers' information sheet was included at the start of the guide. A section explaining how to use the guide was also included.

The graphic design of the guide was edited to achieve more unison with the appearance of the information sheet.

The final design guide is considered a more practical, useful resource because of the developed design stage. The recommendations have been tested and reviewed to ensure they are as straightforward as possible. More context and information have also been provided to give architects a greater understanding of the subject and achieve better design outcomes. The final guide is overall a more comprehensive resource while retaining its straightforward content and appealing aesthetic.

Designing inclusive learning environments for students on the autism spectrum

A resource for designers

Figure 53. Developed design guide

Preface

Children on the autism spectrum often struggle to cope with over-stimulating environments. This can make learning in mainstream primary schools a difficult experience, as students risk being excluded from learning activities. Adjustments to the classroom environment can help improve learning outcomes.

This Design Guide has been developed following a review of literature, analysis of case studies, and conversations with primary school teachers. A list of the literature reviewed is given below. Case studies include schools and autism facilities from New Zealand and overseas. Conversations with primary school teachers took place on 23rd July 2020 and 10th August 2020 at two primary schools located in the Wellington Region.

About autism

Autism or autism spectrum disorder (ASD) is a neurodevelopmental condition that affects communication, social interaction and adaptive behaviour functioning. ASD is an umbrella term that covers the subgroups of autistic disorder, Asperger's disorder (Asperger syndrome), childhood disintegrative disorder (CDD), and pervasive developmental disorder not otherwise specified (PDD-NOS).

Autism is defined as a triad of characteristics: social impairment, communication impairment and repetitive behaviours.
Autism is a very diverse condition, therefore the group of individuals affected have a wide range of severity, disability and intellectual function.

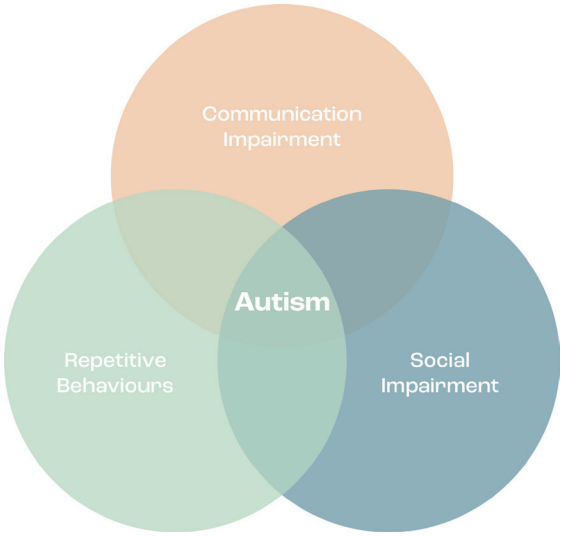


FIgure: 1. The triad of impairments

Boys are four times more likely to develop autism than girls. The cause of autism is not known, although scientists believe that genetics and environmental influences are likely involved.

Approximately 80,000 individuals in New Zealand have autism, although many may not be diagnosed.

The design guide

This guide has been created to assist in the design of learning environments in New Zealand primary schools. The recommendations provided aim to positively impact the learning of students on the autism spectrum.

The recommendations have been divided into seven categories: space, circulation, sensory, indoor environmental quality, finishes, furniture and outdoor space.

The autism design umbrella illustrates all the different design aspects that fall under inclusive learning environments for students on the autism spectrum.

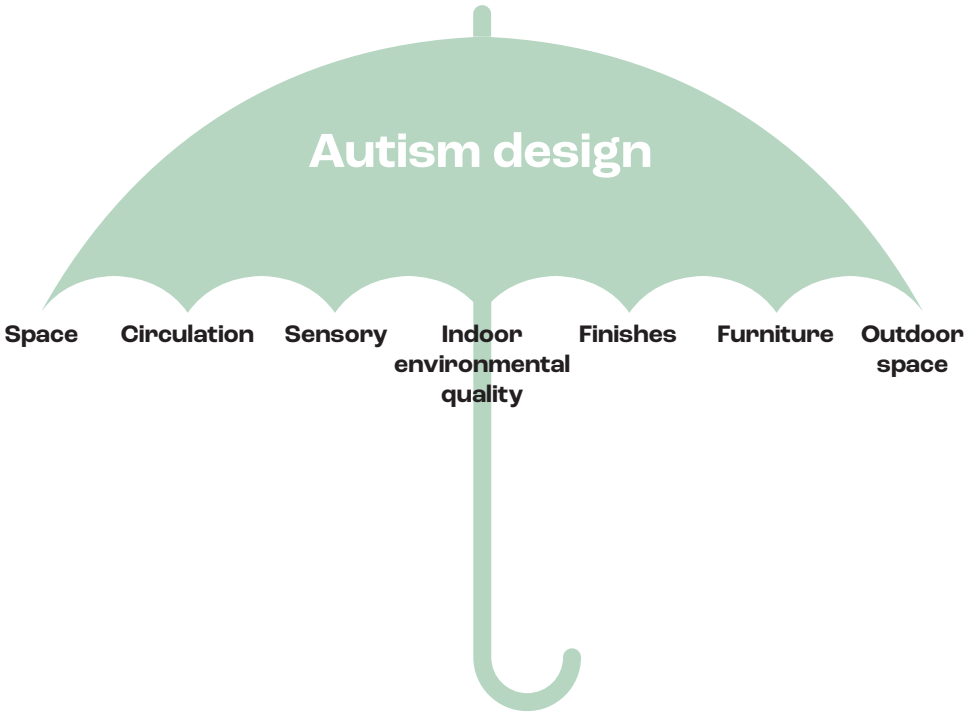
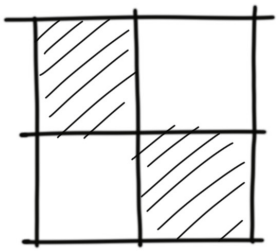
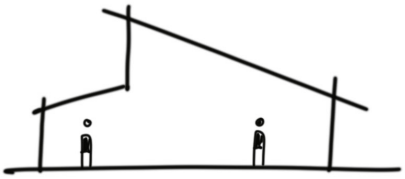


Figure 2. The autism design umbrella

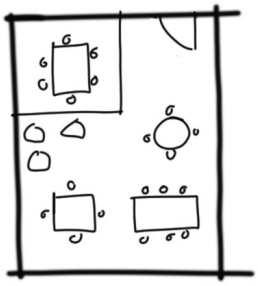
Space



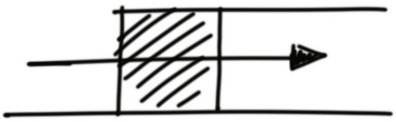
Divide learning spaces into distinct areas



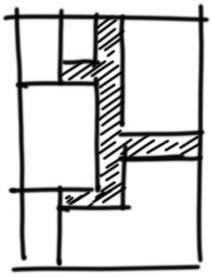
Include changes in height



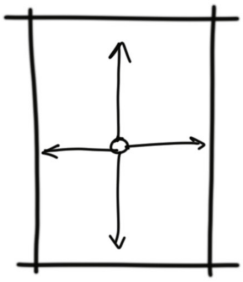
Use a simple layout



Include thresholds between different stimulus levels e.g outside to inside

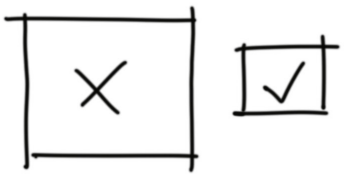


Avoid designing confusing large spaces

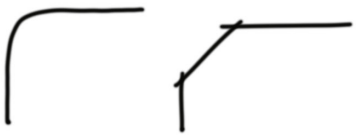


Include clear sightlines across whole area of a learning space

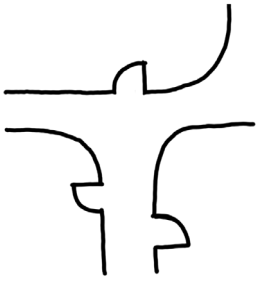
Provide multiple workspaces



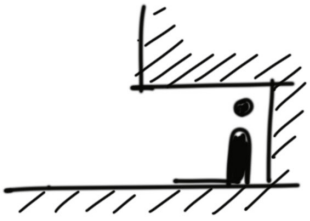
Smaller spaces preferred



Sharp corner edges can be softened with facets or curves

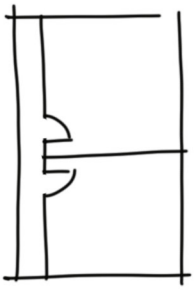


Organic, curvilinear forms can help create a sense of informality

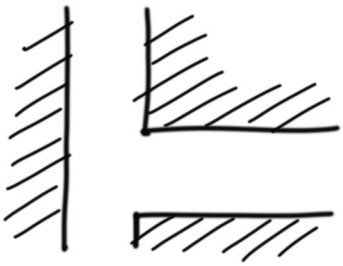


Provide spaces to hideaway

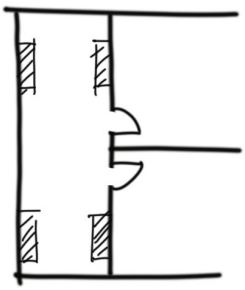
Circulation



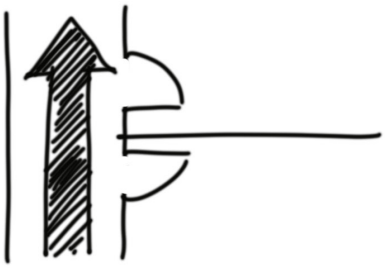
Avoid including narrow corridors



Avoid including blind corners



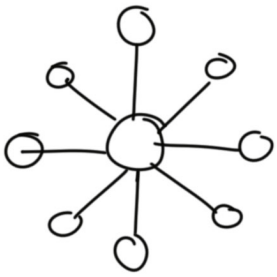
Include circulation space with areas for socialising and self isolation



Make circulation space wide

Make travel routes and distances within the school convenient

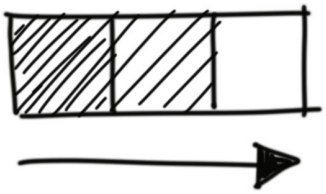
Sensory



Provide a variety of environments and sensory experiences

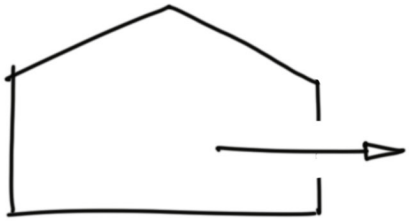
Create a balance between calm and stimulating

Provide quiet spaces, ideally separated from the main learning space

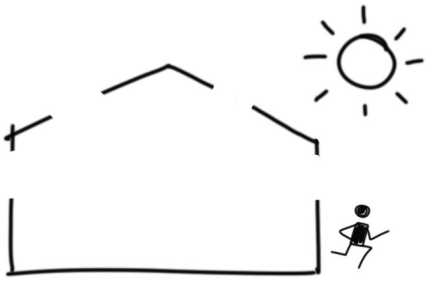


Learning environment should gradually progress to a neurotypical setting each school year

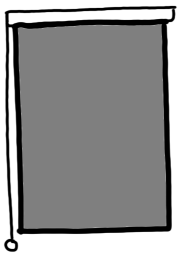
Indoor environmental quality



External views can be distracting.

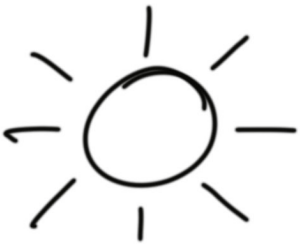


High level glazing allows light to infiltrate spaces while blocking distractions

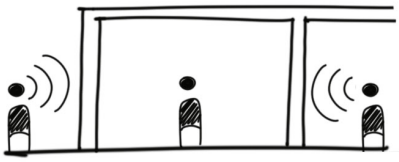


Include blinds to control glare and distractions

LED lamps and dimming switches help provide comfortable lighting [1]



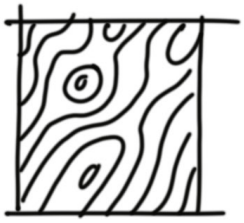
Provide plentiful natural light



Provide quality acoustics and include sound insulation between spaces [2]

1. Refer to 'Designing Quality Learning Spaces - Lighting and Visual Comfort' for lighting requirements
2. Refer to 'Design Quality Learning Spaces - Acoustics' for mandatory sound insulation and impact insulation requirements for internal walls, doors, windows and openings

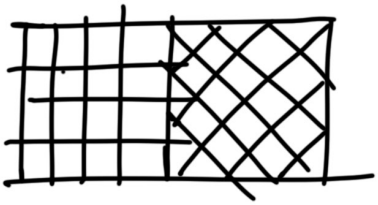
Finishes



Include natural materials

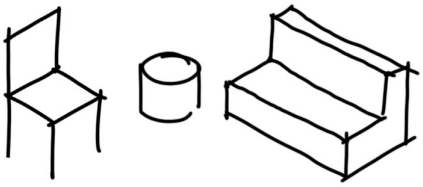
Use acoustic materials e.g. carpet, acoustic wall coverings

Use subdued colours (e.g. blue and green) and avoid bright colours (e.g. red and orange).



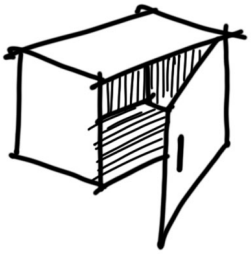
Use visual contrast and texture for sensory wayfinding

Furniture



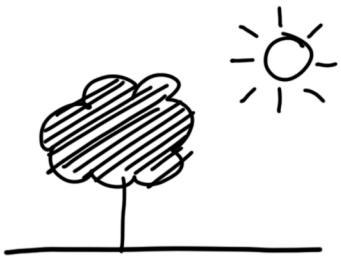
Specify a variety of comfortable, loose furniture. Soft furnishings help control acoustics.

Provide comfortable work spaces

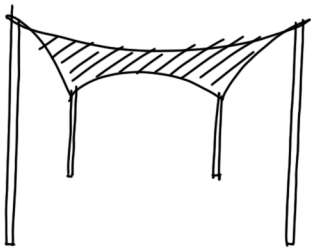


Include generous storage to de-clutter spaces. Closed storage is preferred

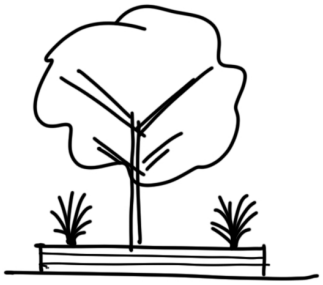
Outdoor space



Outdoor environments are important for learning



Provide shaded play areas



Small courtyard areas allow for small scale interactions

Large-scale playgrounds allow for larger-scale social interactions

Conclusion

09

9.1 Conclusion

This research highlighted the many challenges children with autism deal with at school. Due to the condition's unique characteristics, an autistic individual's experience of the built environment can be significantly intensified.

The research also emphasised the lack of inclusive design features in mainstream NZ primary schools. The design of learning environments in NZ has, for the most part, failed to recognise the needs of students on the spectrum. This could be due to a lack of guidance for architects, something this research has attempted to resolve.

This research asked how the mainstream primary school could provide better learning environments for students on the spectrum. This question's findings were discovered through literature, case studies, school surveys, teachers' participation, and design iterations/testing/reworking. The results were then presented as a design guide for architects and tested through several designs for new and existing learning environments.

The most valuable part of this research was the opportunity to speak to NZ primary school teachers about not only autistic students but also the design of learning environments. While questionnaires and focus groups with two schools provided a generous amount of information, engaging with other schools from other decile levels could have generated a greater range of perspectives. After completing the developed design, further focus groups would also have been useful to gain additional feedback on the design and the design guide.

Time constraints and complexities with ethics prohibited discussions with people on the autism spectrum. Engaging with individuals directly impacted by this research would have provided some invaluable assistance with the investigation.

Site visits to schools across Wellington were also valuable to this research as they highlighted the positive and negative physical features that affect autistic students.

Although the design iterations and concept design demonstrated parts of the design guide, the developed design truly showcased its potential. Although the developed design scope was restricted to learning spaces, an investigation into other school areas, e.g., playground, library, would have been interesting and offered extended testing of the design guide. The design guide could have also been applied to constructing a small real-world design such as an outdoor pod and tested by primary school students for feedback.

The aim of the research was achieved through the findings presented in the design guide and information sheet.

Regarding the research objectives, autism and autism-friendly design were thoroughly researched in the background findings and primary data. This section of the research revealed the lack of advice for the inclusive design of mainstream learning environments.

A design guide to inform the design of autism-friendly primary schools in NZ was produced and refined throughout the research process.

Design solutions for existing and new learning environments were developed and tested, although more effort was dedicated to new environments. This could have been amended by implementing a detailed design for the refurbishment of an existing learning environment.

Although the design guide is the key outcome of this research, the information sheet for existing schools also provides valuable information for educators and designers.

This research highlights the MoE's need to reconsider its approach to the design of learning environments. The current trend towards large learning spaces is not helpful for students on the autism spectrum. The physical environment of modern learning spaces may not be suitable for many students on the spectrum.

The final design guide has the potential to become an essential part of the design process for learning environments. The design solutions in the guide would positively impact both autistic and non-autistic students.

Learning spaces must be inclusive of all learners and all special needs such as autism. It is up to all groups involved in schooling to make the learning environment more accessible to such students. By doing this, more of our youth can have an improved educational experience and a better chance of doing well in life.

9.2 2020 ASFAR Autism conference

On December 11th, 2020, I presented this research at the 2020 Australasian Society for Autism Research Conference. The audience included academics from Australia and NZ involved in autism research. Overall the research was well-received, and the need for such research was raised. The researchers were also interested in how teachers could support students in modern learning environments. The conference was a great opportunity to share the findings of this research with a wider audience and contribute to the conversation on autism research.

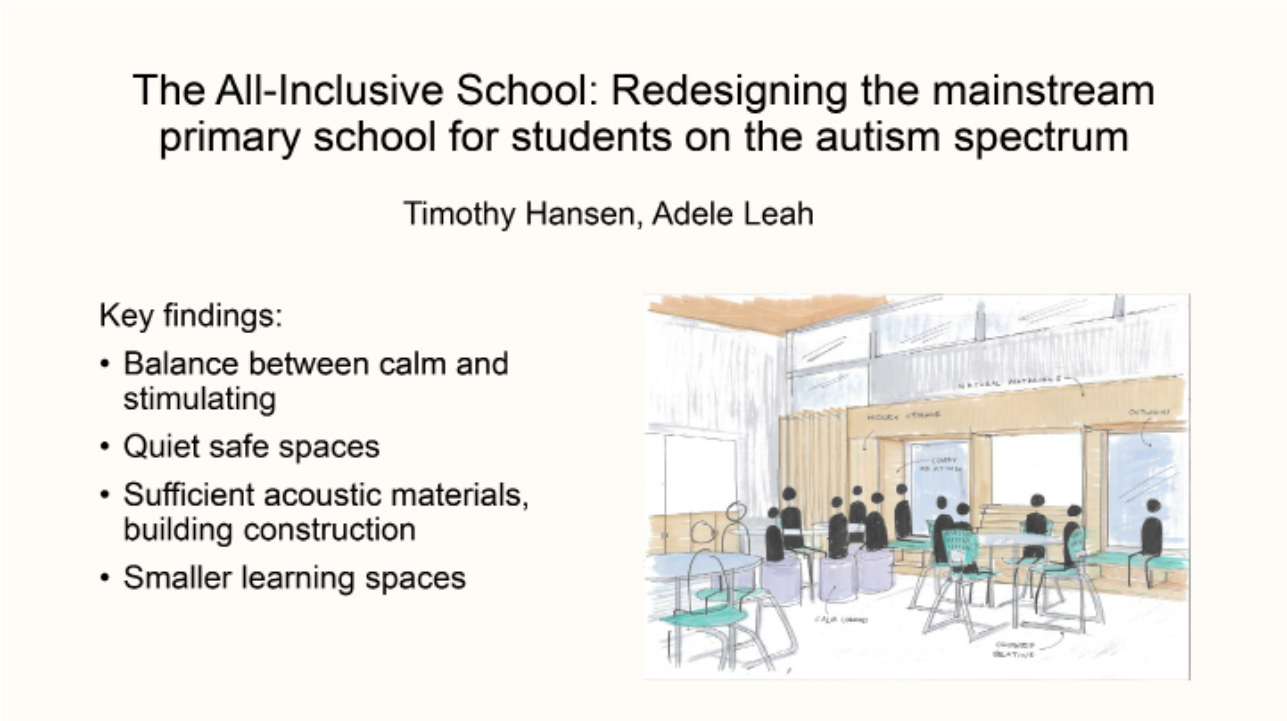


Figure 54. ASFAR Autism Conference slide

Works cited

Altenmüller-Lewis, U. (2017). Designing Schools for Students on the Spectrum. The Design Journal, 20(1), S2215–S2229.

Ambitious about Autism. (n.d.). The Pears National Centre for Autism Education. TreeHouse School. Retrieved 23 March 2020, from http://www.treehouseschool.org.uk/about-us/pears-national-centre-autism-education

Barrie, A. (2019). Teach the children well: Freemans Bay School. Retrieved 4 April 2020, from Architecture Now. https://architecturenow.co.nz/articles/teach-the-children-well-freemans-bay-school/

Bell, J. (2020). What Type of Lighting Should be Used in Schools. Playground Professionals. Retrieved 23 March 2020, from https://playgroundprofessionals.com/play/school-and-education/what-type-lighting-should-be-used-schools

Blaxill, M. F. (2004). What's Going on? The Question of Time Trends in Autism. Public Health Reports, 119(6), 536–551.

Bonnifait + Giesen Architects. (2021). Autism New Zealand. Bonnifait + Giesen Architects. Retrieved 7 March 2021, from https://www.atelierworkshop.com/autism-new-zealand-healthcare

Bozikovic, A. (2017, June 5). 'Design empathy' builds inclusive spaces for people with autism. Retrieved 20 May 2020, from https://www.theglobeandmail.com/life/home-and-garden/design/design-empathy-builds-inclusive-spaces-for-people-with-autism/article23966012/

CDC. (2020, March 26). Autism and Developmental Disabilities Monitoring (ADDM) Network. Centers for Disease Control and Prevention. Retrieved 21 January 2021, from https://www.cdc.gov/ncbddd/autism/addm.html

D. Brunsdon, J. Finnegan, N. Evans, G. Beattie, D. Carradine, J. Sheppard, & B. Lee. (2014). Establishing the resilience of timber framed school buildings in New Zealand.

Department for Children, Schools and Families. (2008, December 17). BB 102 Designing for disabled children and children with special educational needs: Guidance for mainstream and special schools.

GA Architects. (2017, May 11). Colour and best practice in autism design.

Gaines, K., Bourne, A., Pearson, M., Kleibrink, M., Bourne, A., Pearson, M., & Kleibrink, M. (2016). Designing for Autism Spectrum Disorders. Routledge.

Gaines, K. S., Curry, Z., Shroyer, J., Amor, C., & Lock, R. H. (2014). The perceived effects of visual design and features on students with autism spectrum disorder. Journal of Architectural and Planning Research, 31(4), 282–298.

informed decisions. (2020a, December). Grenada Village—Paparangi—Woodridge—Horokiwi Population and age structure. Informed Decisions. Retrieved 16 September 2020, from https://forecast.idnz.co.nz/wellington/population-age-structure?WebID=140

——— 2020b, December). Wellington City Population forecast. Informed Decisions. Retrieved 15 September 2020, from https://forecast.idnz.co.nz/wellington

Jones, K. (2018, July 20). Are modern learning environments working in our schools? Stuff. Retrieved 11 January 2021, from https://www.stuff.co.nz/nelson-mail/news/105196164/are-modern-learning-environments-working-in-our-schools

Learning Environments Australasia. (2013, May 31). Northern School for Autism. Association for Learning Environments. Retrieved 19 March 2020, from http://a4le.org.au/awards/awards-2013/2013-category-1-new-construction/northern-school-for-autism

Litosseliti, L. (2003). Using focus groups in research. Continuum.

Maclean, C. (2015, August 1). Wellington region—Climate. Te Ara - the Encyclopedia of New Zealand; Ministry for Culture and Heritage Te Manatu Taonga. Retrieved 14 January 2021, from https://teara.govt.nz/en/wellington-region/page-3

Mcallister, K. (2010). The ASD Friendly Classroom—Design Complexity, Challenge & Characteristics. Design Research Society International Conference 2010, Montreal, Canada.

Mcallister, K., & Maguire, B. (2012). Design considerations for the autism spectrum disorder-friendly Key Stage 1 classroom. Support for Learning, 27.

McAllister, K., & Sloan, S. (2016). Designed by the Pupils, for the Pupils: An Autism-Friendly School. British Journal of Special Education, 43(4), 330–357.

McKenzie Higham Architects. (2019, December 10). Amesbury School. McKenzie Higham Architects. Retrieved 13 January 2021, from https://www.mckenziehigham.co.nz/projects/amesbury-school/

Ministry of Education. (2010). Services and support in special education for children at school.

——— (2011). The New Zealand school property strategy 2011-2021. Ministry of Education.

——— (2015a, November 18). Furthering the Understanding of Seismic Resilience in the Ministry of Education Buildings.

——— (2015b, October 14). Designing Schools in New Zealand: Requirements and Guidelines. Education in New Zealand.

——— (2016). Autism spectrum disorder (ASD): A resource for educators. Ministry of Education.

——— (2019, June 6). The Wellington Central and North catchment plan. Ministry of Education.

——— (2020a, November 12). Site extensions for schools. Education in New Zealand. Retrieved 16 September 2020, from https://www.education.govt.nz/school/funding-and-financials/funding/site-extensions/

——— (2020b). Designing Quality Learning Spaces – Acoustics.

——— (2020c). Designing Quality Learning Spaces – Lighting.

——— (2020d). Designing Quality Learning Spaces (DQLS) FAQ.

——— (2020e). Plan and build a new teaching space. Ministry of Education. Retrieved 2 February 2021, from https://www.education.govt.nz/school/funding-and-financials/funding/teaching-space-funding/plan-and-build-a-new-teaching-space/

——— (2020f). Designing quality learning spaces. Education in New Zealand. Retrieved 14 January 2021, from https://education.govt.nz/school/property-and-transport/projects-and-design/design/design-standards/designing-quality-learning-spaces/

——— (2021). Designing learning environments. Education in New Zealand. Retrieved 21 January 2021, from http://education.govt.nz/school/property-and-transport/projects-and-design/design/designing-learning-environments/

Mostafa, M. (2008). An Architecture For Autism: Concepts Of Design Intervention For The Autistic User. 2(1), 24.

——— (2014). Architecture For Autism: Autism Aspectss In School Design. International Journal of Architectural Research, 8(1), 143–158.

——— (2018). Designing for Autism: An AspectssTM Post-Occupancy Evaluation of Learning Environments. ArchNet-IJAR : International Journal of Architectural Research; Cambridge, 12(3), 308.

Nair, P., Fielding, R., & Lackney, J. (2005). The language of school design: Design patterns for 21st century schools. Designshare.

Penoyre & Prasad. (n.d.). The Pears National Centre for Autism. Penoyre & Prasad. Retrieved 23 March 2020, from https://www.penoyreprasad.com/project/national-centre-for-autism

Radio New Zealand. (2020). Petone Autism Resource Centre a first in Australasia. RNZ. Retrieved 4 April 2020, from https://www.rnz.co.nz/national/programmes/checkpoint/audio/2018735082/petone-autism-resource-centre-a-first-in-australasia

RTA Studio. (n.d.). Freemans Bay Primary School. Retrieved 10 April 2020, from http://rtastudio.co.nz/portfolio/freemans-bay-primary-school

Russell Properties. (n.d.). Grenada Hunters Hill Subdivision. Russell Properties. Retrieved 10 September 2020, from https://www.russellproperties.co.nz/subdivision-grenada

Shell, S. (2016). Why Buildings for Autistic People Are Better for Everyone. Retrieved 22 January 2021, from https://network.aia.org/HigherLogic/System/DownloadDocumentFile.ashx?DocumentFileKey=3fff74f0-6418-8e5f-00ed-4ebeb38eabd8&forceDialog=0

Tufvesson, C., & Tufvesson, J. (2009). The building process as a tool towards an all-inclusive school. A Swedish example focusing on children with defined concentration difficulties such as ADHD, autism and Down's syndrome. Journal of Housing and the Built Environment, 24(1), 47–v.

Wellington City Council. (2006). Lincolnshire Farm Structure Plan.

Woodridge Homes. (n.d.). About Woodridge. Woodridge Homes. Retrieved 11 September 2020, from https://www.woodridge.co.nz/new_about

World Architecture News. (2011, January 7). National centre for excellence supporting young people with Autism. Retrieved 9 April 2020, frohttp://beta.worldarchitecturenews.com/article/1506782/national-centre-excellence-supporting-young-people-autism?utm_source=website&utm_medium=social

Yang, D. J. (2017). Inquiry into the identification and support for students with the significant challenges of dyslexia, dyspraxia, and autism spectrum disorders in primary and secondary schools.

List of figures

Appendix 1: Positive and negative influences

Positives

- Clearly defined spaces (MoH&E, 2016, p.110) (Gaines et al., 2014, p.292) (Altenmüller-Lewis, 2017, p.S2221)
- Simple layouts (DCSF, 199) (Mcallister and Sloan, 2016, p.16)
- Calm, ordered, low stimulus spaces (DCSF, 2008, p.199).
- Threshold spaces (Altenmüller-Lewis, 2017, p.S2222) (Mcallister and Maguire, 2012, p.107)
- Access to social spaces (MoE, 2016, p.25)
- Quiet/escape spaces (MoH&E, 2016, p.119) (MoE, 2016 p.13–14) (DCSF, 2008, p.199) (Mcallister and Maguire, 2012, p.109) (Gaines et al., 2014, p.292) (Mostafa, 2008, p.203–04) (Altenmüller-Lewis, 2017, p.S2223–24) (Tufvesson and Tufvesson, 2009, p.54)
- Safe indoor and outdoor spaces (DCSF, 2008, p.199)
- Variety of environments and sensory experiences (Mcallister and Sloan, 2016, p.16)
- Glare-free controllable lighting (DCSF, 2008, p.25)
- Indirect lighting (DCSF, 2008, p.199)
- High-level glazing (Mcallister and Maguire, 2012, p.108)
- Natural daylight (Altenmüller-Lewis, 2017, p.S2225) (Gaines et al., 2014, p.292–93)
- High-quality acoustics (DCSF, 2008, p.25) (Altenmüller-Lewis, 2017, p.S2224) (Mostafa, 2008, p.203–04)
- Sound insulation between rooms and from outside (DCSF, 2008, p.149)
- Neutral and calming colours (Altenmüller-Lewis, 2017, p.S2225) (Gaines et al., 2014, p.295) (DCSF, 2008, p.199)
- Natural materials (Altenmüller-Lewis, 2017, p.S2225)
- Visual contrast and texture utilised in sensory wayfinding (DCSF, 2008, p.25)
- Robust materials, tamper-proof elements and concealed services (DCSF, 2008, p.199)
- Shaded play areas (MoH&E, 2016, p.109)
- Outdoor learning spaces and playgrounds (Mostafa, 2014, p.154) (Mcallister and Sloan, 2016, p.17) (Mcallister and Maguire, 2012, p.109)
- Conducive wayfinding and navigation (Altenmüller-Lewis, 2017, p.S2223)
- Multi-use circulation spaces (Altenmüller-Lewis, 2017, p.S2223)
- Convenient travel routes and distances (DCSF, 2008, p.38)
- Well organised classroom visuals (Gaines et al., 2014, p.292)
- Visual timetables (Mcallister and Maguire, 2012, p.108)
- Loose interior furnishings (Tufvesson and Tufvesson, 2009, p.56–57)
- Closed storage (Tufvesson and Tufvesson, 2009, p.56–57)
- Conducive furniture arrangements (Mostafa, 2008, p.203–04)
- Personal seating places (Tufvesson and Tufvesson, 2009, p.56–57) (MoH&E, 2016, p.110)
- One-on-one teaching (Tufvesson and Tufvesson, 2009, p.53)
- Individual work (Tufvesson and Tufvesson, 2009, p.56–57)
- Teaching in an inclusive environment with other children (MoH&E 2016 p.16)

Negatives

- Noisy spaces (MoH&E, 2016, p. 09). (MoE, 2016, p.13–14)
- Spaces without sound-dampening (MoH&E, 2016, p.109)
- Poor artificial lights (MoH&E, 2016, p.109)
- Harsh sunlight (MoH&E, 2016, p. 109)
- Flickering, noisy light fittings (DCSF, 2008, p.199) (Altenmüller-Lewis, 2017, p.S2225)
- Background noise (DCSF, 2008, p.25) (Tufvesson and Tufvesson, 2009, p.53)
- Spaces with long reverberation times and acoustically highly reflective surfaces (DCSF, 2008, p.149)
- Confusing large spaces (DCSF, 2008, p.199)
- Hazards, security risks and behavioural triggers (Altenmüller-Lewis, 2017, p.S2220)
- Corridors (Altenmüller-Lewis, 2017, p.S2223)
- Harsh fluorescent fittings (Altenmüller-Lewis 2017 p.S2225) (Gaines et al. 2014 p.292–93)
- Overly stimulating colours (Altenmüller-Lewis, 2017, p.S2225)
- Exterior views (Mcallister and Maguire, 2012, p.108). (Gaines et al., 2014, p.292–93) (Tufvesson and Tufvesson, 2009, p.56)
- Excessive clutter (MoH&E, 2016, p.110)
- Sound filtration (Tufvesson and Tufvesson, 2009, p.53)
- Large class sizes (Tufvesson and Tufvesson, 2009, p.53)
- Class teaching (Tufvesson and Tufvesson, 2009, p.53)
- Multiple doors (Tufvesson and Tufvesson, 2009, p.56)
- Multiple windows (Tufvesson and Tufvesson, 2009, p.56)
- Direct daylight (Tufvesson and Tufvesson, 2009, p.56–57)
- Open storage (Tufvesson and Tufvesson, 2009, p.56–57)

Appendix 2: HEC Application

The All-Inclusive School

INFORMATION SHEET FOR SCHOOLS

Thank you for your interest in this project. Please read this information before deciding whether or not your school will take part. If you decide to participate, thank you. If you decide not to take part, thank you for considering my request.

Who am I?

My name is Timothy Hansen and I am a Masters student in Architecture at Victoria University of Wellington. This research project is work towards my thesis.

What is the aim of the project?

This project aims to discover how the education of students with Autism Spectrum Disorder (ASD) in New Zealand can be improved through the physical design of the mainstream primary school. Your participation will support this research by helping me to understand how students (and especially those students with ASD) operate in the classroom. This research has been approved by the Victoria University of Wellington Human Ethics Committee (application no. 28487).

How can you help?

If you agree to take part, I will send questionnaires to, and conduct focus groups with, small groups of your teachers. Teachers will be invited to participate via. email, and I will provide each teacher with an individual information sheet and consent form. I will ask teachers questions about the influence of the physical and social environment on autistic students in their classroom. The focus groups will take approx. 1.5 hours, and teachers will be expected to take part outside of their teaching time. The interviews will take place at your school if allowable, or via. Zoom if the government's lock down level prohibits this. I will audio record the focus group with the permission of the participants and write it up later. The information shared on questionnaires and within the focus groups will be confidential, meaning that I and my supervisor will know who participated, but the identities of the participants will be protected.

What will happen to the information the participants give?

The participants and your school will not be named in the final report. Only my supervisor and I will read the notes or transcript of the focus group. The focus group transcripts, summaries and any recordings will be kept securely and destroyed on 31st July 2021. Be aware that the identities and contributions of participants will be kept confidential from your school.

What will the project produce?

The information from my research will be used in my Masters thesis. The information may also be presented at conferences or in journal articles.

If you accept this invitation, what are the rights of your school?

You do not have to accept this invitation if you don't want to. If you do decide that your school will participate, you have the right to:

- ask any questions about the study at any time;
- withdraw your school's participation from the study before 31st July 2020, however, individual participants will retain the right to decide if their data will be withdrawn;
- be able to read the completed Masters thesis, provided via email.

If you have any questions or problems, who can you contact?

If you have any questions, either now or in the future, please feel free to contact either:

Student:
Name: Timothy Hansen
University email address:
hansentimo1@myvuw.ac.nz

Supervisor:
Name: Dr Adele Leah
Role: Senior Lecturer
School: Architecture
Phone: 0220 742025
adele.leah@vuw.ac.nz

Human Ethics Committee information

If you have any concerns about the ethical conduct of the research you may contact the Convenor of the Victoria University of Wellington Human Ethics Committee: Associate Professor Judith Loveridge, email hec@vuw.ac.nz or telephone +64-4-463 6028.

Appendix 2: HEC Application

The All-Inclusive School

CONSENT TO PARTICIPATE (SCHOOL)

This consent form will be held for five years.

Researcher: Timothy Hansen, Architecture, Victoria University of Wellington.

- I have read the Information Sheet and the project has been explained to me. My questions have been answered to my satisfaction. I understand that I can ask further questions at any time.
- I agree that my school will take part.

I understand that:

- I may withdraw this school from this study at any point before 31st July 2020 and the information provided up to this date by individual members of the school will be used in the project (with their permission).
- Any information the participants provide will be included in a final report but the transcripts/observation notes/recordings will be kept confidential to the researcher and the supervisor.
- The identities of the participants will not remain confidential to the researcher and supervisor.
- I understand that the results will be used for a Masters' thesis and potentially in conference presentations and/or journal articles.
- I would like to receive a copy of the final report (thesis) and have added my email address below. Yes ☐ No ☐

Signature of participant: _____

Name of participant: _____

Date: _____

Contact details: _____

The All-Inclusive School

INFORMATION SHEET FOR PARTICIPANTS

You are invited to take part in this research. Please read this information before deciding whether or not to take part. If you decide to participate, thank you. If you decide not to participate, thank you for considering this request.

Who am I?

My name is Timothy Hansen and I am a Masters student in Architecture at Victoria University of Wellington. This research project is work towards my thesis.

What is the aim of the project?

This project aims to discover how the education of students with Autism Spectrum Disorder (ASD) in New Zealand can be improved through the physical design of the mainstream primary school. Your participation will support this research by helping me to understand how students (and especially those students with ASD) operate in the classroom. This research has been approved by the Victoria University of Wellington Human Ethics Committee (application no.28487).

How can you help?

You have been invited to participate because of your experience as a primary school teacher. If you agree to take part, you will be asked to complete a questionnaire and will also be part of a focus group at your school if allowable, or via. Zoom if the government's lock down level prohibits this. I will ask you and other participants' questions about the influence of the physical and social environment on autistic students in your classroom. The focus group will take approx. 1.5 hours. I will audio record the focus group with your permission and write it up later.

The information shared on the questionnaire and during the focus group is confidential. That means after the focus group, you may not communicate to anyone, including family members and close friends, any details about the identities or contributions of the other participants of the focus group.

You can withdraw from the focus group at any time before the focus group begins.

Appendix 2: HEC Application

You can also withdraw while the focus group it is in progress. However it will not be possible to withdraw the information you have provided up to that point as it will be part of a discussion with other participants.

What will happen to the information you give?

You and your school will not be named in the final report. Only my supervisor and I will read the notes or transcript of the focus group. The focus group transcripts, summaries and any recordings will be kept securely and destroyed on 31st July 2021.

What will the project produce?

The information from my research will be used in my Masters thesis. The information may also be presented at conferences or in journal articles.

If you accept this invitation, what are your rights as a research participant?

You do not have to accept this invitation if you don't want to. If you do decide to participate, you have the right to:

- choose not to answer any question;
- ask for the recorder to be turned off at any time during the focus group;
- withdraw from the focus group while it is taking part however it will not be possible to withdraw the information you have provided up to that point;
- ask any questions about the study at any time;
- read over and comment on a written summary of the focus group, provided via email;
- be able to read any reports of this research by emailing the researcher to request an emailed copy.

If you have any questions or problems, who can you contact?

If you have any questions, either now or in the future, please feel free to contact either:

Student:	**Supervisor:**
Name: Timothy Hansen	Name: Dr Adele Leah
University email address:	Role: Senior Lecturer
hansentimo1@myvuw.ac.nz	School: Architecture
	Phone: 0220 742025
	adele.leah@vuw.ac.nz

Human Ethics Committee information

If you have any concerns about the ethical conduct of the research you may contact the Victoria University of Wellington HEC Convenor: Associate Professor Judith Loveridge. Email hec@vuw.ac.nz or telephone +64-4-463 6028.

Appendix 2: HEC Application

The All-Inclusive School

CONSENT TO PARTICIPATE IN FOCUS GROUP

This consent form will be held for five years.

Researcher: Timothy Hansen, Architecture, Victoria University of Wellington.

- I have read the Information Sheet and the project has been explained to me. My questions have been answered to my satisfaction. I understand that I can ask further questions at any time.
- I agree to take part in an audio recorded focus group.

I understand that:

- I acknowledge that I am agreeing to keep the information shared during the focus group confidential. I am aware that after the focus group, I must not communicate to anyone, including family members and close friends, any details about the identities or contributions of the other participants of the focus group.
- I can withdraw from the focus group while it is in progress however it will not be possible to withdraw the information I have provided up to that point as it will be part of a discussion with other participants
- The identifiable information I have provided will be destroyed on 31st July 2021.
- I understand that the findings may be used for a Masters Thesis and potentially in conference presentations and/or journal articles.
- I understand that the observation notes/recordings will be kept confidential to the researcher and the supervisor.
- I understand that school consent has been provided
- My name will not be used in reports and utmost care will be taken not to disclose any information that would identify me.

- I would like a summary of the focus group: Yes ☐ No ☐
- I would like to receive a copy of the final report (thesis) and have added my email address below. Yes ☐ No ☐

Signature of participant: _____

Name of participant: _____

Date: _____

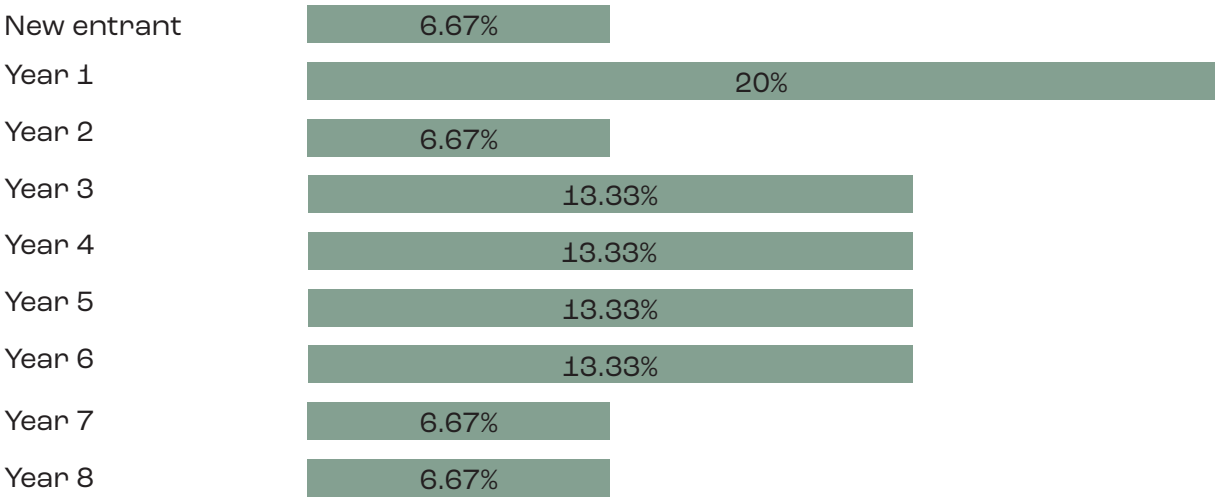
Contact details: _____

Appendix 2: HEC Application

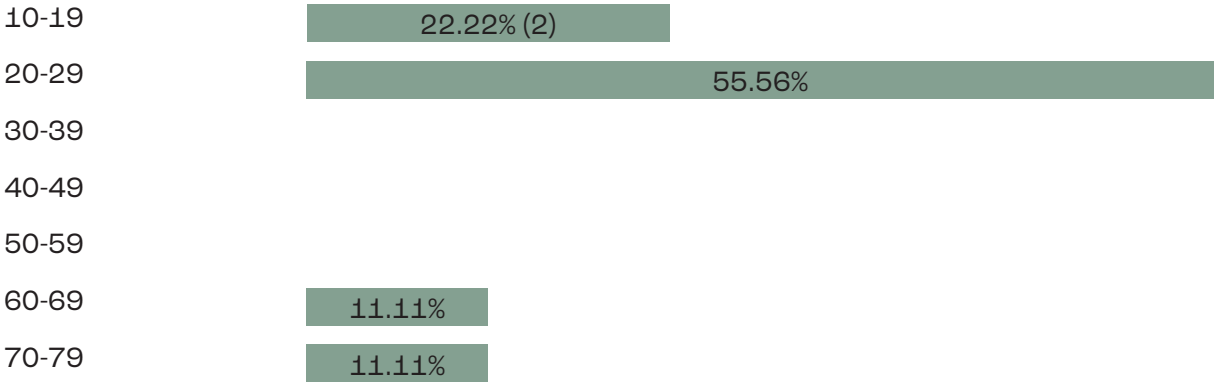
Content unavailable

Appendix 3: Questionnaire results

What year group/s do you teach?



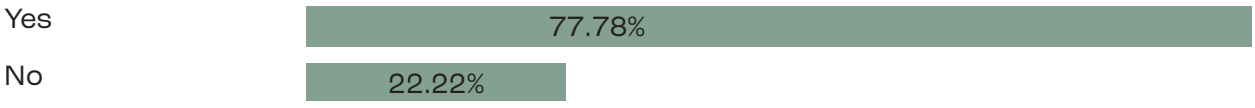
How many students do you have in your classroom at any one time?



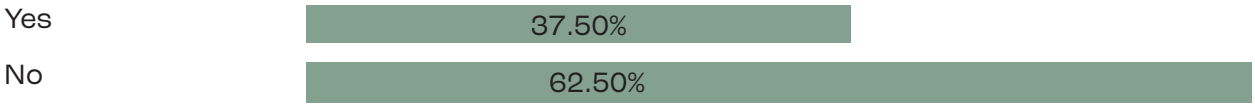
Do any of the students in your class have autism spectrum disorder (ASD)?

If so, how many?

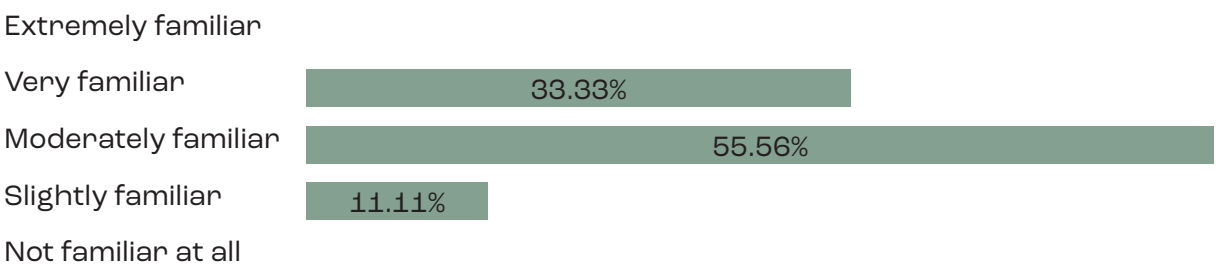
Have you taught students with ASD in the past?



Do you have students with other learning disabilities?



How familiar are you with ASD?



Do you believe that the physical design of a classroom space can positively impact the learning of all students?

Do you believe that the physical design of a classroom space can positively impact the learning of students with ASD?

Do you believe that the physical design of a classroom space can negatively impact the learning of all students?

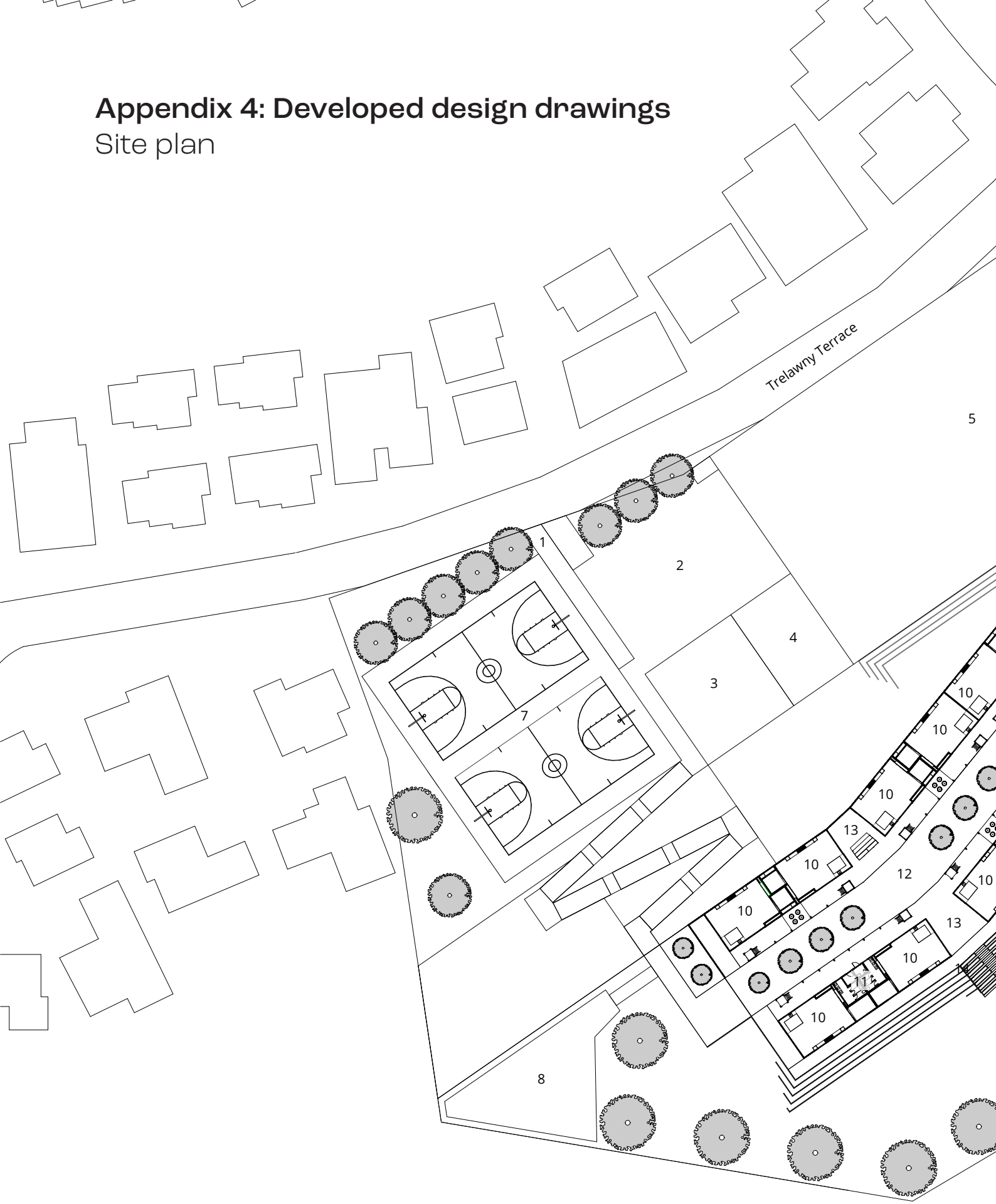
Appendix 3: Questionnaire results

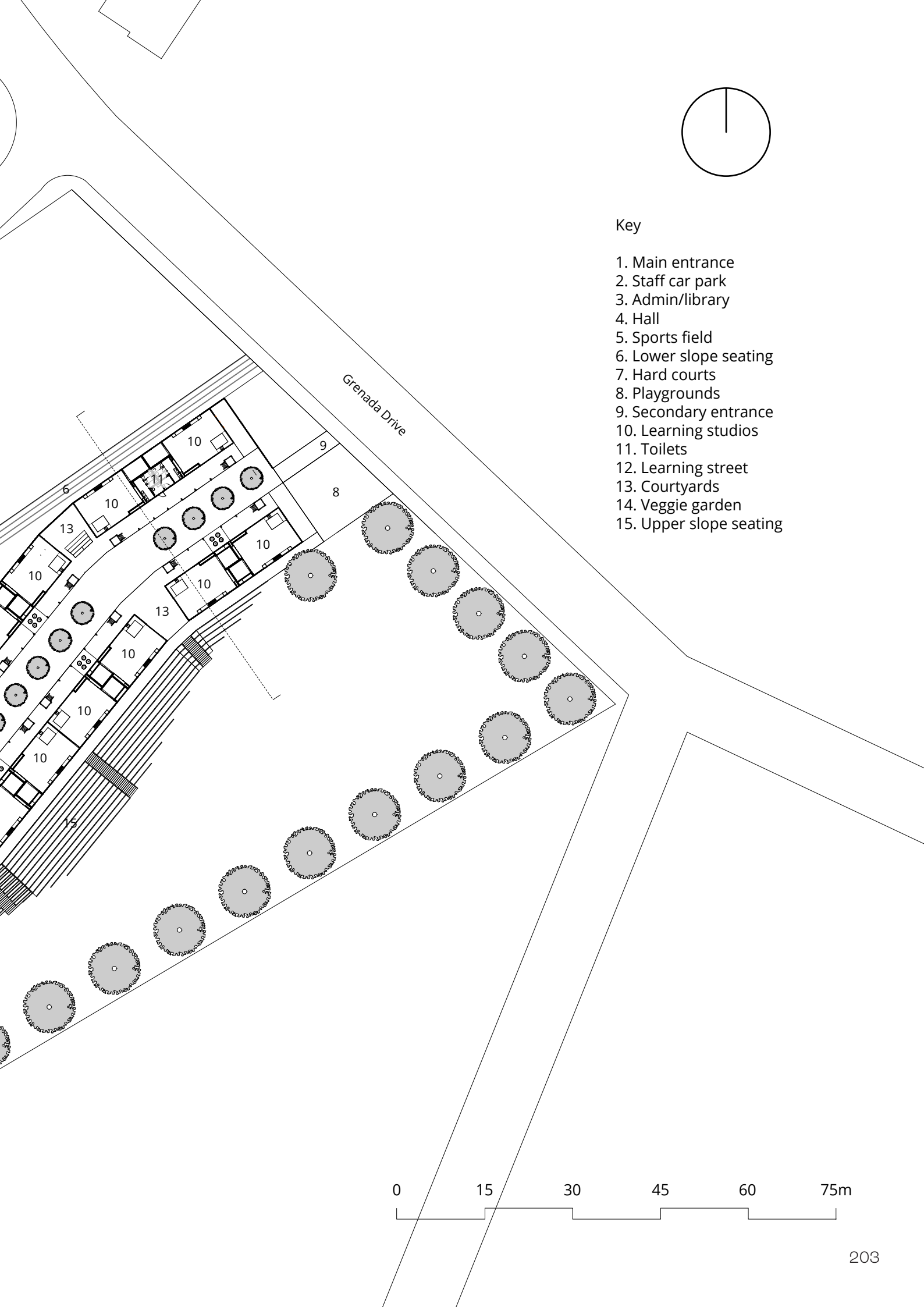
Do you believe that the physical design of a classroom space can negatively impact the learning of students with ASD?

Do you believe that the physical design of your school is supportive of the learning of students with ASD?

Appendix 4: Developed design drawings

Site plan



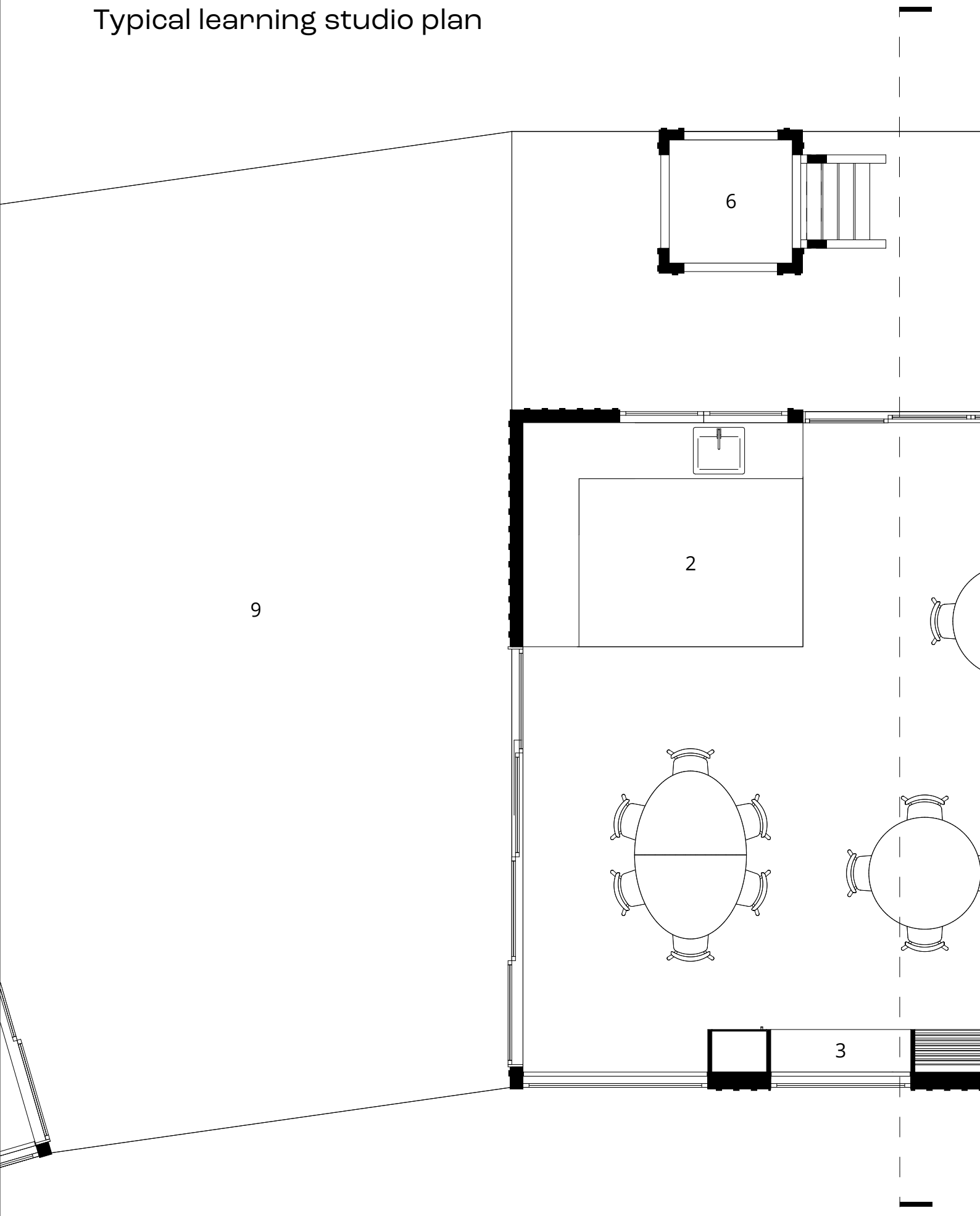


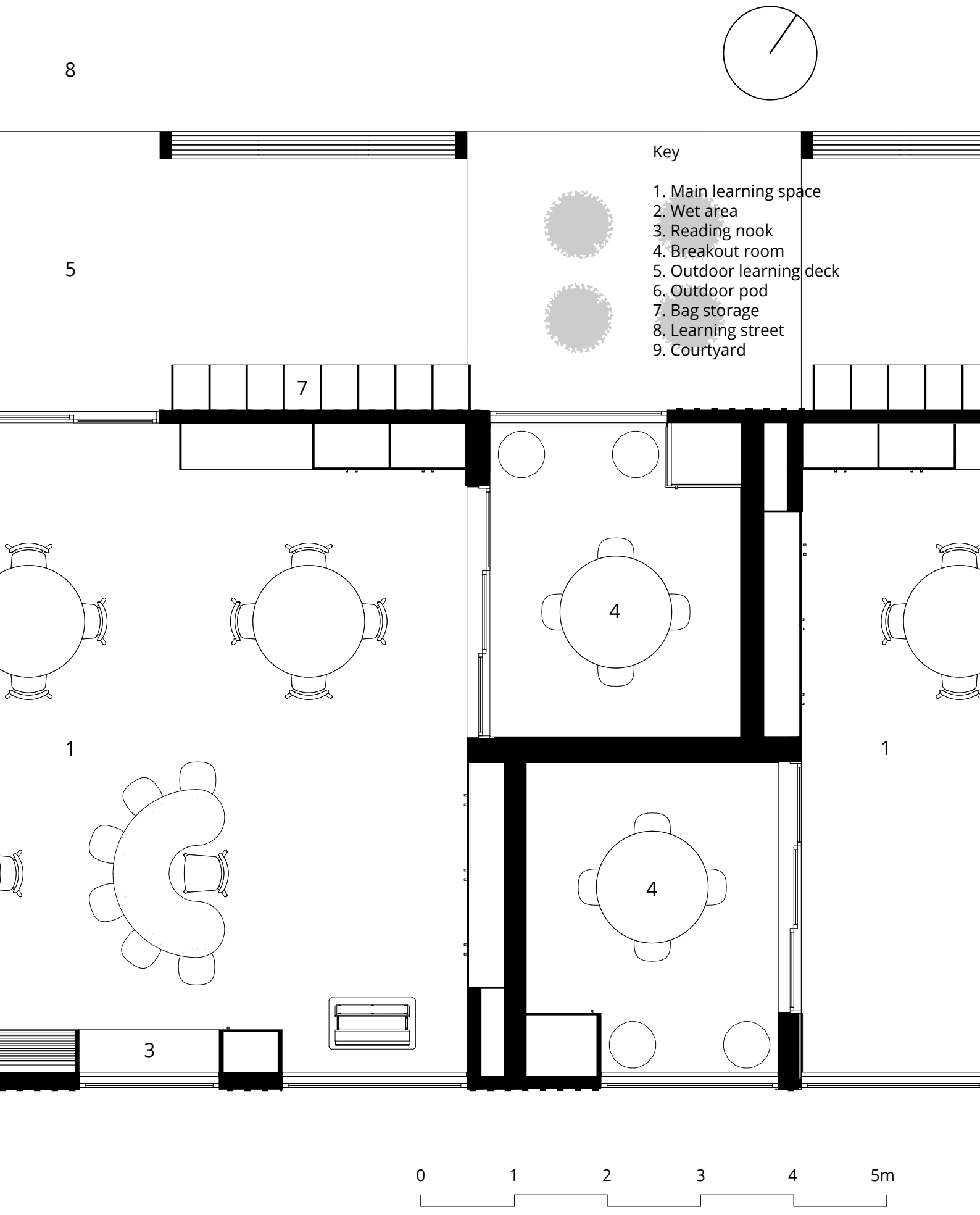
Key

1. Main entrance
2. Staff car park
3. Admin/library
4. Hall
5. Sports field
6. Lower slope seating
7. Hard courts
8. Playgrounds
9. Secondary entrance
10. Learning studios
11. Toilets
12. Learning street
13. Courtyards
14. Veggie garden
15. Upper slope seating

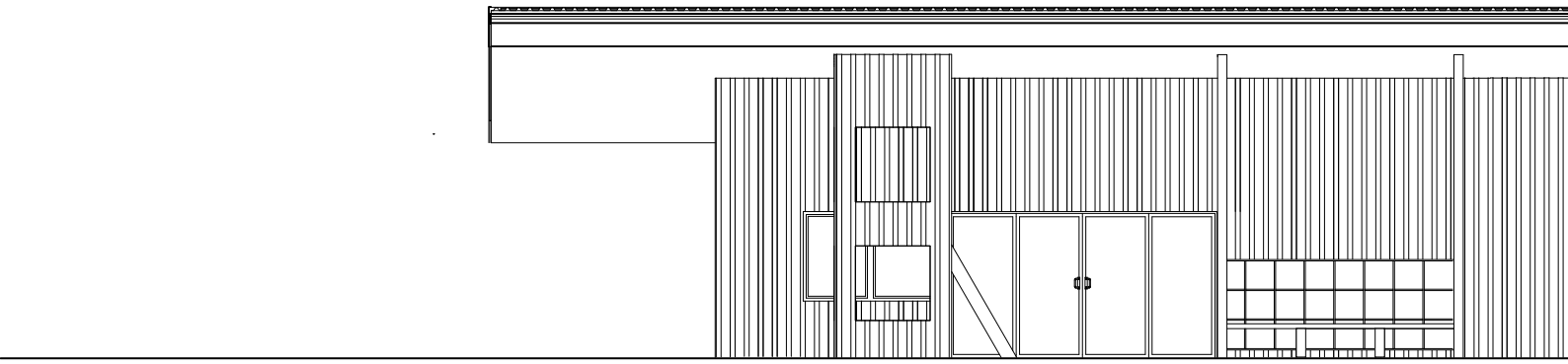
0 15 30 45 60 75m

Typical learning studio plan



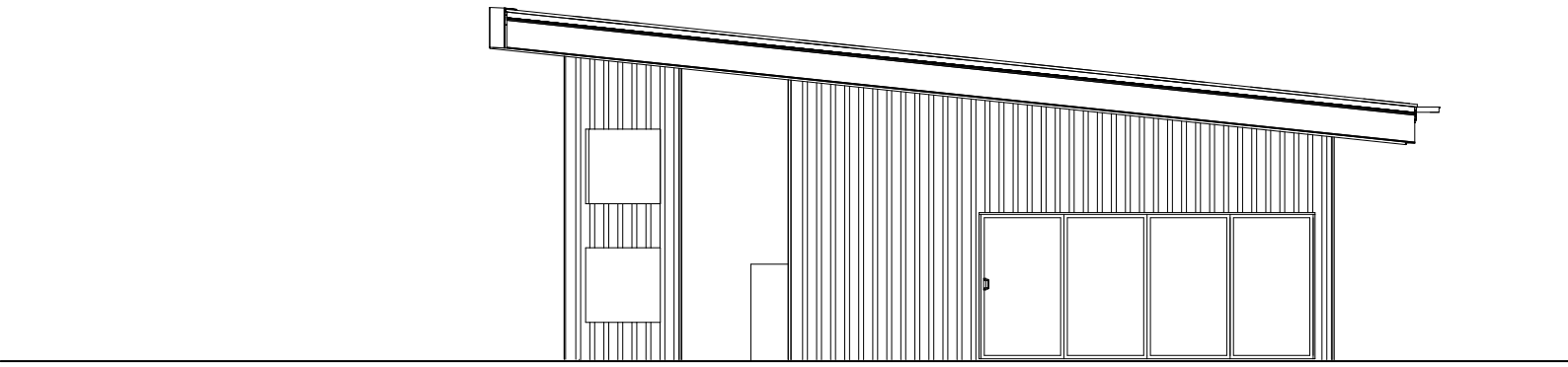

8
5
7
1
4
4
1
3
Key
1. Main learning space
2. Wet area
3. Reading nook
4. Breakout room
5. Outdoor learning deck
6. Outdoor pod
7. Bag storage
8. Learning street
9. Courtyard
0
1
2
3
4
5m

Elevations



North-West Elevation (entrance)

South-East Elevation

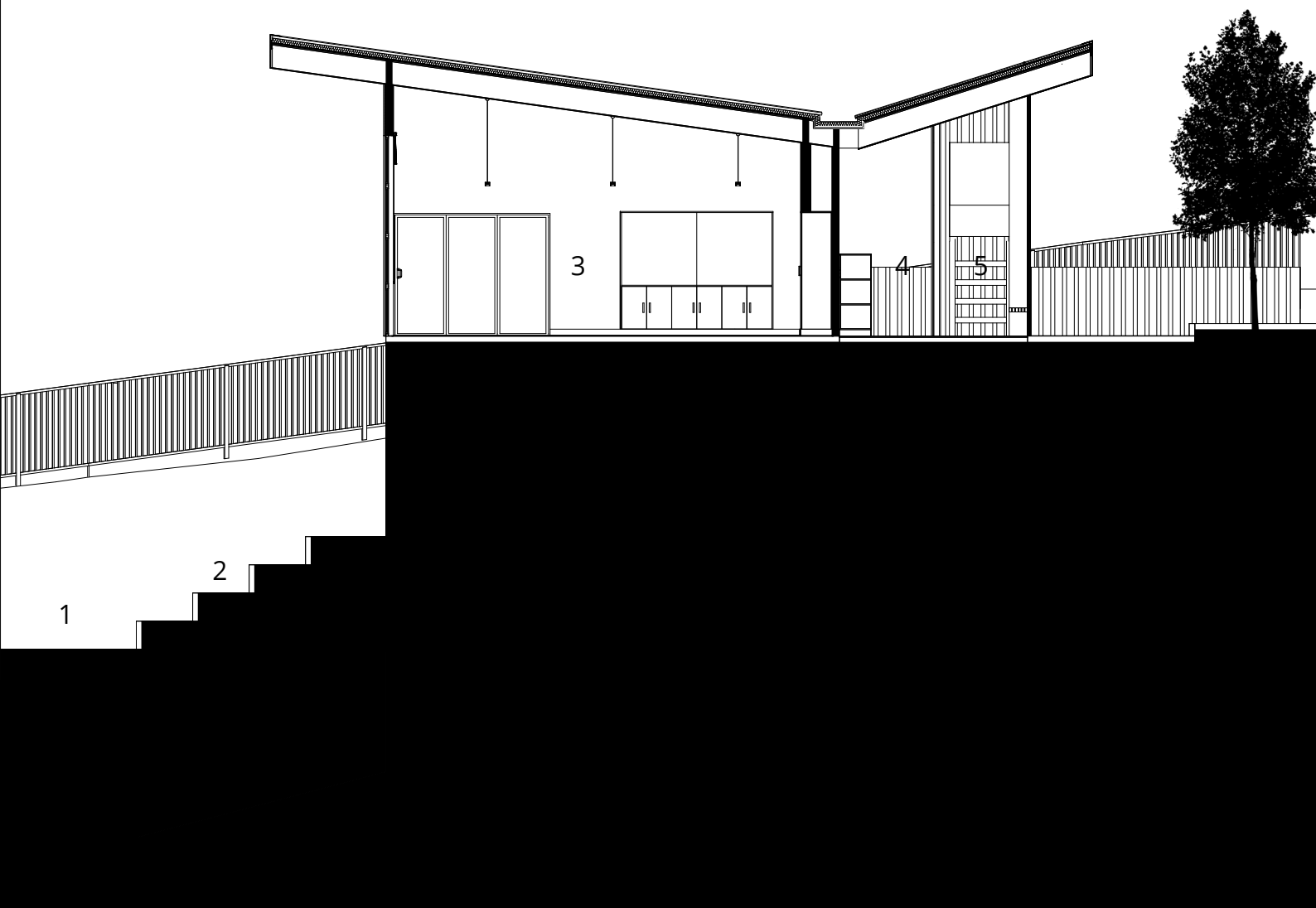


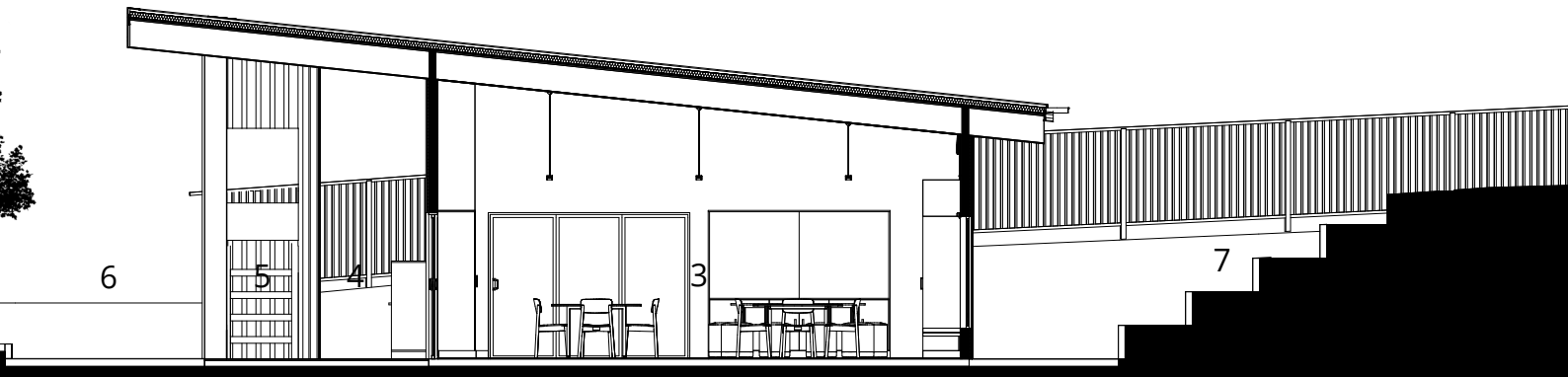
South-West Elevation

South-East Elevation

0 2 4 6 8 10m

Section





Key

1. Sports field
2. Lowe slope seating
3. Learning studio
4. Outdoor learning deck
5. Outdoor pod
6. Learning street
7. Upper slope seating

0 2 4 6 8 10m