National SCIENCE Challenges

Post-Occupancy Evaluation of Neighbourhoods: a review of the literature

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Recommended citation
Boarin, P., Besen, P., & Haarhoff, E. (2018). *Post-Occupancy Evaluation of Neighbourhoods: a review of the literature*. Working Paper 18-01. Auckland, New Zealand: National Science Challenge 11: Building Better Homes, Towns and Cities.

This report is available from: http://www.buildingbetter.nz/resources/publications.html

Building Better Homes, Towns and Cities National Science Challenge

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Abstract

This literature review presents the state of the art of Post-Occupancy Evaluation (POE) of neighbourhoods. POE is a useful way of confirming the actual performance of the built environment, including quantitative and qualitative data. Although POEs are commonly used in the building scale, there are limited examples of POEs in large scale, including communities, cities and regions. Therefore, this report presents the main methodologies and examples internationally and in New Zealand. Within the existing methodologies, existing assessment and certification schemes for neighbourhoods are presented and compared. At the end of this report, a proposed framework for the Post-Occupancy Evaluation of the selected case study of Hobsonville Point is proposed, including a questionnaire for residents.

This report is designed to offer a frame of reference for subsequent research in to New Zealand's neighbourhood context and to provide an overview of the application of Post-Occupancy Evaluation at the neighbourhood scale, focusing on environmental performance and liveability. Relevant sections of literature have been kept as original quotes, in order to ensure that this review can be used as a tool for writing subsequent research reports and articles.

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1. Post-Occupancy Evaluation

1.1. The "Performance Gap"

There has been a lot of advancement in the field of sustainable buildings and neighbourhoods in the last decades, including the development of several rating tools to evaluate their performance. However, there often is "a significant difference between predicted (computed) energy performance of buildings and actual measured energy use once buildings are operational" (de Wilde, 2014, p. 40). The performance of these complex systems is different in theory versus in reality – what came to be known as the "performance gap". The differences between the expected and the actual performance of buildings - in terms of energy performance and indoor environment - have been linked to two main causes: i) defects in the building systems and envelope, and ii) the influence of buildings' occupants (Guerra-Santin & Tweed, 2015).

Similar issues and lack of data can be encountered in analysing the performance of sustainable neighbourhoods:

> Despite the growth in the number of neighbourhood scale projects (and the many frameworks for sustainable neighbourhood accreditation and assessment that have emerged in parallel), little is yet known of the extent to which they are meeting their stated goals. The way sustainable neighbourhoods are actually performing from the perspective of their occupants is particularly poorly understood, including the ways in which the selection of specific landscape features, building forms or individual technologies affect resident experiences and by extension, the actual performance of the project. (Westerhoff, 2016, p. 2)

This lack of real data is also reported about the performance of New Zealand mixed-use neighbourhoods:

> Debates on the merits or otherwise of the intensification of urban settlements and the trend to mixed use neighbourhoods have to date been largely uninformed by empirical evidence. Those debates continue as territorial authorities throughout the country attempt to optimise the social and economic as well as environmental performance of New Zealand's cities and towns. (Saville-Smith, 2008, p. 5)

One key concept that can help minimise the "performance gap" is the application of Post-Occupancy Evaluation to assess the in-use performance of buildings or entire

neighbourhoods. It is important to note that the "performance" of a neighbourhood is not only the fulfilment of a list of requirements to minimise its environmental impact, but also how successful it is in creating liveable spaces, creating opportunities for connections between residents, and encouraging sustainable practices.

1.2. The definition of Post-Occupancy Evaluation (POE)

Post-Occupancy Evaluation was created for assessing buildings and is commonly used for this purpose nowadays. POE is based on the concept that, by asking users about their needs and experiences in the built environment, better spaces can be designed. One of the main definitions for Post-Occupancy Evaluation is the following:

> (…) the process of evaluating buildings in a systematic and rigorous manner after they have been built and occupied for some time. POEs focus on building occupants and their needs, and thus they provide insights into the consequences of past design decisions and the resulting building performance. This knowledge forms a sound basis for creating better buildings in the future. (Preiser, Rabinowitz, & White, 1988, p. 3)

The scope of POE has broadened in recent years. Consequently, there is no industry-accepted definition of POE; nor is there a standardized method for organising a POE (Federal Facilities Council Staff, 2000). Therefore, the methodologies for POE are diverse and there are many possibilities of how to conduct it.

One of the most accepted models for POE is the integrative framework for building performance evaluation, involving six major phases of the building delivery and life cycles: planning, programming, design, construction, occupancy, and recycling of facilities (Preiser & Schramm, 1997). The integrative framework shown in Figure 1 aims to reflect the complex nature of performance evaluation in the building delivery cycle, as well as its complete life cycle. This framework defines the building delivery cycle from a designer's perspective, showing its cyclic evolution and refinement toward a moving target of achieving a better quality as perceived by the building occupants and a better overall performance (Federal Facilities Council Staff, 2000).

Figure 1 - Building performance evaluation: integrative framework for building delivery and life cycle (based on (Federal Facilities Council Staff, 2000).

Stevenson and Rijal (2010) have defined the POE framework as the evaluation of quantitative aspects that provide a physical performance baseline and qualitative aspects related to the evaluations of user responses or their behaviour. For the quantitative factors, it is important to define the indicators to be compared with the actual performance before starting the monitoring activity. These indicators can be obtained from many sources, such as requirements defined in building regulations, requirements from building certification methods, or Standards i.e. European Standards, ASHRAE Standards or ISO Standards (Guerra-Santin & Tweed, 2015).

1.3. Lessons learned from the Post-Occupancy Evaluation of buildings

Post-Occupancy Evaluation of buildings has proven to be an effective measure, encouraging the development of a design process that takes into consideration the final users' perceptions and experiences in the built environment.

Nowadays, people and organizations have higher expectations for buildings. Owners expect that their investments will result in buildings that improve worker's productivity, the company's image and profit; that are sustainable, adapt to new uses, accessible, energy efficient, and cost-effective to build and to maintain; and meet the needs of their clients. Users expect that buildings will be functional, comfortable, safe and will not harm their health; therefore the performance of a building can be defined as its capacity to meet these promises (Federal Facilities Council Staff, 2000).

According to Zimmerman, POEs provide valuable information for design decisions for current and future projects:

> The over-arching benefit from conducting POEs is the provision of valuable information to support the goal of continuous improvement. Traditionally, many decisions that are made in the programming or design stage of building projects are based on assumptions of how the organization functions and how people use their spaces. A proper POE will provide real information on which to base decisions, and real information is key to informing and improving the next project. (Zimmerman & Martin, 2001, p. 169)

According to Guerra-Santin & Tweed, the benefits of building performance evaluation are abundant; among them are: 1) feedback to designers, 2) improved performance, 3) improved services by those who provide them, 4) contributions to a wider knowledge base, 5) long-term owning and operative costs, and 6) competitive advantage (Guerra-Santin & Tweed, 2015). Therefore, results from POEs can be used to improve not only the specific buildings being assessed, but also to advance overall knowledge about users expectations and needs.

2. Post-Occupancy Evaluation of Neighbourhoods

Although the application of POE in the built environment has grown around the globe in recent decades, a number of authors report that the practice of POE at the neighbourhood scale is still limited. Churchman & Ginosar have identified this gap in 1999:

> The literature which deals with the post-occupancy evaluation of neighborhoods is relatively meagre when compared with the literature on the evaluation of more limited and more easily defined environments, such as student dormitories, public institutions, such as hospitals or schools, and office environments, or open spaces such as play areas and parks. (Churchman & Ginosar, 1999, p. 267)

The authors argue that one of the reasons for the lack of POEs in neighbourhoods is the complexity of the evaluation at this scale, when compared to the building scale:

> There are many studies of housing, as masterfully summarized by Cooper Marcus and Sarkissian (1986). However, most of these are not post-occupancy evaluations in the strict sense of the term, and further they focus mainly on the buildings and the immediate surroundings, and do not relate to the neighborhood. The main reason for this difference seems to lie in the complexity of the neighborhood, as opposed to the relative simplicity of the more limited environments. The complex mix of distinctive features within a neighborhood renders the commonly used, structured evaluation methods inappropriate. Researchers in the area of environment-behavior studies are apparently aware of this dissonance, and daunted by the absence of an alternative approach, they have refrained from carrying out research which evaluates neighborhoods as a whole. This has, in turn, led to a dearth of systematic information on which to base the neighbourhood planning process. (Churchman & Ginosar, 1999, p. 267)

This lack of information may have impacts on the effectiveness of urban planning, as the authors argue that systematic collection of data would benefit the planning and design process:

> As a result, neighborhood and urban planners have been forced to rely for their recommendations and plans on the analysis of demographic, socio-economic and physical data, which provide only a general picture of the neighborhood. In order to fill out this general picture, they sometimes use partial unsystematically collected information, some of it intuitive, that they have assembled in the course of their work. Neither of these two types of information, important as they are in themselves, can serve as a substitute for systematically collected data from the residents themselves when evaluating a neighborhood. There is thus a need for an evaluative approach suited to the particular characteristics of residential neighborhoods, which would enable detailed and systematic information to be collected on the quality of the mutual interactions between the residents and the physical environment. Such an approach would encourage researchers and planners

to include research evaluating the neighborhood as part of the planning process. (Churchman & Ginosar, 1999, p. 267)

In 2008, Hofer reported the lack of real data about well-known neighbourhoods which are often considered as examples of liveability and environmental performance:

Seldom have post-occupancy evaluation of these community-building efforts been undertaken on such a scale and rarely are POEs undertaken in a multifaceted, comprehensive fashion. While anecdotal or journalistic "evidence" may suggest how these communities perform for their residents and other users, little analytical evidence is available to guide policy refinement or direction or to develop new policies for large-scale developments of this type. (Hofer, 2008, p. 1)

The author highlights the importance of POEs at different scales and stages of developments:

Assessment and evaluation provide the essential feedback on the soundness of planning policy and decisions and hopefully promote continuous improvement in building and neighbourhood design and construction. (…) POEs are not restricted to evaluating buildings only, but can also be applied to the public realm, accessibility, connectivity and issues of social or tenure mix and diversity. POEs can range in scale and scope to assess anything aspect of occupant satisfaction from the fine details of a specific site to general sentiments about a master-planned development. To be most effective, performance evaluation must occur throughout the lifecycle of the area or building being studied. A well designed and conducted POE will be informed by environmental psychology and, depending on the findings, may contribute to further understanding in this field. Providing data and information to inform decision-making about the built environment is the overarching goal of all good POEs. The evaluation of the built form and the spaces it informs are considered by many to be an essential step of any development. Yet POEs and Building Performance Evaluations (BPEs) are not essential components of practice. (Hofer, 2008, p. 2)

Moreover, the author identifies many benefits that can be gained with POEs in neighbourhoods:

Evaluations can identify what is or isn't working for a user of a given space, as well as theorize about the systemic reasons why space works or doesn't. This process can save time, effort and resources if it successfully informs future practice. Cases where buildings and spaces have had to be demolished and re-designed because the space was not congruent with the users' needs are well known. By adopting POEs and BPEs as leading practice, planners and designers can gain in confidence that their decisions with respect to the built form are being favourably perceived by the users of those spaces. POEs also have a role to play in assessing the environmental performance and sustainability-related concerns raised by building design and functioning. (Hofer, 2008, p. 2)

More recently, Whitfield has investigated the state of the art in monitoring sustainable communities and has highlighted the importance of this practice:

> Post occupancy monitoring is extremely important in evaluating the success of sustainable community developments. There are many developers building sustainable community developments with intentions of having fewer negative environmental impacts than experienced with conventional community developments. While developers are advancing the field of sustainable development, the surveys from several sustainable community developments indicate there is very little research occurring. Monitoring is crucial to understanding whether or not their strategies are actually effective at reducing environmental impacts (Whitfield, 2017, p. 71).

In the same year, Westerhoff also identified the gap in the evaluation of sustainable neighbourhood performance in the post-occupancy stage:

> The way sustainable neighbourhoods are actually performing from the perspective of their occupants is particularly poorly understood, including the ways in which the selection of specific landscape features, building forms or individual technologies affect resident experiences and by extension, the actual performance of the project (Westerhoff, 2016, p. 2).

Szibbo argued that the spotlight of current neighbourhood rating systems has been only on the design and construction stages, rather than their in-use performance:

> Unfortunately, the focus in the current rating system remains on the presence of specific features of built form or the inclusion of procedures, and does not address how well those features or procedures are efficiently or effectively functioning (Szibbo, 2016, p. 11).

Therefore, the gaps that occur in the environmental performance of buildings are also present in neighbourhoods: the effort in designing and building sustainable spaces might not be effective without some effective management and engagement from its residents. For instance, a new development might reduce parking spaces and design high quality bicycle and pedestrian paths as an incentive for active transport modes – but none of these initiatives will be effective if the residents don't use them. Applying POEs is essential for identifying these gaps and helping solve them in the long-term.

This section will discuss existing methodologies and examples of POEs in neighbourhoods.

2.1. Existing Methodologies for the Evaluation of Neighbourhoods

As POEs of buildings, the neighbourhood scale POEs should also include both quantitative and qualitative assessments. As discussed about building scale POEs, there is no established standard or guideline for the application of POEs in neighbourhoods. There are diverse approaches that can be followed and POEs are usually developed according to specific requirements for each context.

Hofer argued that the use of quantitative and qualitative methods offers the opportunity of triangulation between findings, which allows the construction of a multi-layered picture of the state of the neighbourhood (Hofer, 2008).

In 1999, Churchman & Ginosar proposed a framework for the Post-Occupancy Evaluation of Neighbourhoods from the Environmental Psychology perspective. Their guidelines were based upon three theories:

> The first two - the ecology of human development approach (Bronfenbrenner, 1976, 1979; Bronfenbrenner & Crouter, 1983), and the transactional world view (Altman & Rogoj, 1987; Altman, 1988) enable us to cope with the complexity of residential neighborhoods, and provide the principles on which we base the proposed approach. The third theory is the naturalistic inquiry paradigm (Lincoln & Guba, 1985), whose principles and operational guidelines we consider to be the most appropriate for the realization of these principles. (Churchman & Ginosar, 1999, p. 268)

In 2011, Kytta has developed a web-based methodology for planning evaluation from the inhabitants' point of view, which is based on SoftGIS collection, one kind of public participation GIS method (PPGIS). This type of data collection enables users to express their everyday environmental, locality-based experiences:

> A new soft geographic information system methodology, softGIS, has the potential to enhance planning evaluation by allowing residents the possibility to share their place-based knowledge of their living environment with urban planners and researchers. SoftGIS is an internet-based methodological approach that relies on collecting, analysing and delivering soft, localised knowledge produced by the residents in a certain area. Compared to the traditional survey questionnaires, the localised experiential knowledge that can be collected with softGIS methods brings along several benefits. First, the place-based experiential knowledge is connected with specific design and planning solutions for the physical environment. Therefore, the localised experiential knowledge is more useful for planners than the traditional criteria-based evaluations. (Kytta, 2011, p. 336)

This is a good example of the application of technology to collect and organise data from multiple inputs from residents. However, this system contributes to the qualitative component of the POE only, as it only considers experiential feedback from users – there is no measurement or observation of facts.

A key reference for large scale POEs are the indicators contained in the many existing certification schemes for neighbourhoods. Although most of these tools were developed to be applied in the pre-design and construction stages, their credits and indicators can be useful if applied in the post-occupancy stage as well, allowing relevant comparisons with similar developments and best practice industry standards. Table 1 summarises the main frameworks and standards for sustainable neighbourhood development.

Table 1. Summary of existing assessment schemes for neighbourhoods

Name	Organisation	Year	Country	Summary of key aspects	Indicators categories
ISO 37120: Sustainable Development in Communities - Indicators for city services and quality of life	International Organisation for Standardisation (ISO)	2014	EU	Defines indicators to evaluate the sustainable development and resilience in existing communities.	Economy, Education, Energy, Environment, Finance, Fire & Emergency, Governance, Health, Recreation, Safety, Shelter, Solid Waste, Telecommunication & Innovation, Transportation, Urban Planning, Wastewater, Water & Sanitation
BREEAM® Communities	Building Research Establishment (BRE)	2008	UK	Evaluation of communities in 3 steps within the design and construction process: principle, layout, details	Social and economic wellbeing, Resources and energy, Land use and ecology, Transport and movement
LEED® for Neighborhood Development (LEED-ND)	United States Green Building Council (USGBC)	2009	USA	A system that certifies the sustainability of neighbourhoods using an integrated set of principles for public & private master plans worldwide.	Smart location and linkage, neighborhood pattern and design, green infrastructure and buildings, innovation, regional priority
Living Community Challenge[SM]	International Living Future Institute	2014	USA	A framework for master planning, design, and construction, to create a symbiotic relationship between people and all aspects of the built environment. It aims to	Place, water, energy, health & happiness, materials, equity, beauty

				create communities that are as connected and beautiful as a forest.	
Green Star Communities	Green Building Council of Australia (GBCA)	2012	Australia	Defines a vision, a set of principles and aspirations to help guide and support the development of sustainable communities.	Governance, Liveability, Economic prosperity, Environment, Innovation
The Neighbourhood Sustainability Framework	Beacon Pathway	2012	New Zealand	Framework for the evaluation of existing neighbourhoods via an Observational Tool and a Resident Survey Tool	Functional flexibility, Neighbourhood satisfaction, Minimised costs, Maximised biophysical health, Appropriate resource use & climate protection, Effective governance & civic life
STAR Community Rating System	Sustainability Tools for Assessing and Rating communities (STAR)	2012	USA	Framework and certification program for evaluating local sustainability. Local leaders use the evaluation measures to assess their current level of sustainability, set targets for moving ahead, and measure progress along the way.	Built Environment, Climate & Energy, Economy & Jobs, Education Arts & Community, Equity & Empowerment, Health & Safety, Natural Systems, Innovation & Process
DGNB New Urban Districts	German Sustainable Building Council (DGNB)	2012	Germany	Scheme including all areas relevant to sustainable building: from the location and energy supply of the district, to public space amenities and mixed use, sustainable mobility and reducing costs throughout the entire life cycle.	Environmental quality, economic quality, socio-cultural and functional quality, technical quality and process quality
One Planet Living	Bioregional	2003	UK	Rooted in the science and metrics of ecological and carbon footprinting, ten One Planet principles are used to structure thinking and inform holistic action.	Health and Happiness, Equity and local economy, Culture and community, Land and nature, Sustainable water, Local and sustainable food, Travel and transport, Materials and products, Zero waste, Zero carbon energy

The differences between the certification schemes reflect diverse regional views on sustainability and liveability, as well as different weighting on environmental, social and economical aspects of sustainable development.

ISO 37120 was designed to assist cities in leading and assessing the performance of the management of city services, service provisions and quality of life. It considers sustainability as its general purpose and resilience as a guiding approach in the development of urban environments. All indicators shall be compiled on an annual basis. The indicators contained in the ISO standard are more applicable to larger scale evaluations of entire cities and can be used in diverse socio-economic contexts. In general, the application of this standard to smaller communities is limited, as its indicators are focused on larger scales. For instance, one of the core indicators within the Health section is the number of in-patient hospital beds per 100,000 population, which can't be evaluated in a smaller community where there is no hospital. However, other parameters can be easily used in any scale: Fine particulate matter concentration, NO_2 concentration, Square meters of public outdoor recreation space per capita (ISO, 2014).

BREEAM® Communities was a pioneer scheme for neighbourhoods, which has been used as a reference for the development of other schemes. The scheme is organised according to the different stages of the design process, starting from principles then progressing to layout and details (BRE, 2012).

LEED®-ND is more focused on the design and construction of neighbourhoods, rather than their management. This scheme offers a technical approach with quantifiable parameters for the performance of communities, aiming to encompass environmental, social and economic aspects. In terms of scale, The LEED®-ND project should contain at least two habitable buildings and be no larger than 1500 acres. (USGBC, 2017). However, social and economic aspects are given less weight than the environmental parameters, as reported by Szibbo (2015).

Green Star Communities has a strong focus beyond the initial construction of neighbourhoods, defining many measures for the management of communities in the long term. Economical sustainability is also a strong aspect of this certification scheme, ensuring

the availability of jobs for the residents. Each credit offers prescriptive and performance pathways, giving more flexibility to the developments.

The Living Community Challenge[SM] has more subjective approaches, and a focus on the humanisation and liveability of communities, which is presented in the Health & Happiness, Equity and Beauty petals.

Beacon Pathway's framework is the only one developed specifically for the post-occupancy assessment of communities, rather than the design stage. It contains both quantitative and qualitative methods, via an Observational Tool and a Resident Survey Tool (Beacon Pathway, 2017).

The STAR Community Rating System was built by and for local governments in the United States. This scheme evaluates existing communities, cities and counties and allows them to benchmark their sustainability progress against national standards and their peers (Star Communities, Our Framework, 2017). The data about certified communities is available online, and the system offers rankings according to each criteria, which encourages cities to make continuous improvements.

DGNB New Urban Districts focus on the areas between buildings in a neighbourhood, such as sidewalks, bike lanes, roads, and green spaces. In addition, overriding concepts are also taken into consideration, for instance for energy, water, and waste. The basic conditions for the development of buildings in the district play a major role, but buildings themselves do not need to be certified for district certification. The minimum size for this certification system is 2 ha of gross development area (GDA) (DGNB, 2017).

The One Planet Living framework was created with the lessons learned BedZED eco-village. It is a flexible sustainability scheme, as it suggests some Indicators, Key Performance Indicators (KPIs) and Targets, but developers might set themselves the targets associated with these indicators (Bioregional, 2016).

A more detailed comparison between these different neighbourhood assessment systems is given in Appendix 1, where four main schemes for the New Zealand context were compared: LEED[®]-ND, BREEAM Communities, Green Star Communities and the Beacon Pathway Neighbourhood Sustainability Framework. The choice was to focus on the two main international schemes and two local schemes. In order to structure this comparison, the

sustainable urban design framework developed by Larco (2015) was used as a reference, as it presents a comprehensive categorisation of all aspects involved in the design of sustainable neighbourhoods. This comparison was built to structure the proposed POE framework for the future case study of this research.

2.2. Examples of Post-Occupancy Evaluation of Neighbourhoods Internationally

Although the use of POE in neighbourhoods is still limited, a few cases have been successful in providing comprehensive evaluations that can serve as an example for future research. There are many examples of studies that deal with only one single theme, i.e. surveys for transportation only or crime prevention only. However, for this research, examples were selected to focus on thorough evaluations encompassing multiple criteria, as this is in line with the purpose of comprehensive POEs.

2.2.1. Indexes of perceived residential environment quality and neighbourhood attachment in urban environments - Rome, Italy

In 2003, Bonaiuto et al conducted a survey on the perceived residential environment quality and neighbourhood attachment in the city of Rome:

> This paper presents two instruments measuring the quality of the relationship that inhabitants have with their urban neighbourhoods. These instruments consist of 11 scales measuring the perceived environmental qualities of urban neighbourhoods and one scale measuring neighbourhood attachment. The 11 scales are included in four generative criteria as follows: three scales concern spatial aspects (i.e. architectural-planning space, organization and accessibility of space, green space); one concerns human aspects (i.e. people and social relations); four concern functional aspects (i.e. welfare, recreational, commercial, transport services); three concern contextual aspects (i.e. pace of life, environmental health, upkeep).
>
> The study objectives were: (a) to compare the structure and number of both indexes of perceived environmental quality and the neighbourhood attachment index with respect to the findings of a study that used a previous version of these instruments; (b) to improve the psychometric qualities (i.e. internal consistency coefficients) of the used tools.
>
> The instruments have the form of a self-reported questionnaire which was administered to 312 residents in seven neighbourhoods (differing in various features) of a great urban

context like the city of Rome. A series of Principal Component Analyses (PCA) was performed on the data. (Bonaiuto, Fornara, & Bonnes, 2003, p. 41).

The following reference areas were investigated: 1) Architectural/town-planning features, 2) Socio-relational features, 3) Functional features, 4) Context features, 5) Neighbourhood attachment. The factors were bipolar, i.e. consisting of both positive-sense items indicating presence of environmental quality and negative-sense items indicating absence of environmental quality. For example, in the investigation of "external connections", positive-sense items included good neighbourhood connections with the city-centre and other city areas, while negative-sense items addressed neighbourhood isolation and difficulties in reaching the neighbourhood from other parts of the town.

> Results confirm the factorial structure of the scales, which include 19 perceived quality indexes (150 items total) and one neighbourhood attachment index (eight items). The scales show an increased level of reliability with respect to earlier studies. (Bonaiuto, Fornara, & Bonnes, 2003, p. 41)

One point to be highlighted is that the study only included qualitative data. In the conclusions it is suggested that "A further research line to be developed is a comparison between residents' perceived quality of neighbourhoods and experts' technical evaluations of the same places, to assess when these two evaluations converge and when they diverge." (Bonaiuto, Fornara, & Bonnes, 2003, p. 51) This would be a step further in advancing the knowledge of objective and subjective environmental assessments that can then be used as a base for environmental management strategies and neighbourhood interventions.

2.2.2. Sustainability versus liveability - an investigation of neighbourhood satisfaction – Dublin, Ireland

Howley et al. have investigated the relationship between sustainability and liveability through a post-occupancy assessment of Dublin's central city, which has attracted large numbers of residents back into the urban core since the early 1990s. The survey included 50 apartment developments randomly chosen; a questionnaire was distributed by post to 1050 of these apartment units, with a total of 270 completed questionnaires returned:

> Recent years have witnessed an increasing emphasis placed on planning systems in most advanced capitalist societies to develop a more sustainable urban development pattern,

resulting in policies to increase residential densities. Although belief in the virtues of the compact city approach is now widespread among the policy community, questions remain relating to the 'sustainability versus liveability' implications of compact city environments. In this regard, while the public may support sustainability principles, there is a perception that high density development poses too great a cost on individuals' quality of life. Combining both quantitative and qualitative research data, this paper evaluates the relationship between high-density living and neighbourhood satisfaction within the central city. Findings suggest that, in many instances, it is not high density per se that is the source of dissatisfaction for respondents, but rather other related factors such as environmental quality, noise, lack of community involvement, traffic and lack of services and facilities (Howley, Scott, & Redmond, 2009, p. 847)

Specific questions were asked about the main problems found in the neighbourhood. Litter was the most relevant issue found by residents, followed by anti-social behaviour. Figure 2 shows the main responses, showing the frequency of answers (from the total of questionnaires), as well as the percentage in relation to the total.

	Frequency	%
Crime/safety		
Anti-social behaviour from the young	51	21.2
Crime	48	19.9
Drug taking/drug trafficking	32	13.3
Alcohol misuse/drunks	32	13.3
Vandalism	15	6.2
Security/safety	21	8.7
Environmental factors		
Litter	52	21.6
Pollution	19	7.9
Traffic	44	18.3
Noise	37	15.4
Facilities		
Lack of shops	18	7.4
Parking	10	4.1
Lack of amenities	8	3.3
Lack of facilities for children	8	3.3
No recycling facilities	6	2.4
Lack of open space	5	2.1
Community issues		
Lack of community involvement/spirit	18	7.4
Social housing and related issues	10	4.1
Other		
Cost of living/cost of accommodation	8	3.3
No problems	6	2.4
Management companies	6	2.4
Homeless people	5	2.1
Other	26	10.8
Total	485	

Figure 2. Main problems found in the neighbourhood (Howley, Scott, & Redmond, 2009, p. 857).

2.2.3. SFU UniverCity Resident Survey – Burnaby, Canada

Since 2007, Mustel Group has been conducting resident evaluations of the SFU UniverCity in Burnaby, Metro Vancouver. In 2016, 288 UniverCity residents completed an online survey from a total of 2,008 households that were invited to participate.

> In an attempt to better understand the demographic make-up of UniverCity's resident population and further gather feedback regarding their attitudes, opinions, expectations and needs of their community, an online survey was conducted with invitations mailed to all households on a postcard. The survey was first designed in 2007 then updated and repeated in 2010, 2012 and 2014, with the survey completed on paper by mail in 2007 and 2010, and online in 2012, 2014 and 2016. (Mustel Group and SFU Community Trust, 2010, p. 1)

This continuous evaluation allows comparisons with previous years and assists in making improvements in the community. Figure 3 shows the main "likes" from residents compared across five surveys since 2012. As it can be observed, different ratings can be found in different years. Overall, the natural setting of the UniverCity development and the location stand as the most appealing factors about the community. The surveys by Mustel Group is a good example of continuous evaluation during the life cycle of the project and a relevant reference for the use of technology for POEs in neighbourhoods.

Likes:	2007 (318) %	2010 (275) %	2012 (273) %	2014 (208) %	2016 (288) %
Natural setting/fresh air	34	36	38	38	38
Sense of community/good for families/ neighbours/friendly atmosphere	10	25▲	29	39▲	36
Quiet/tranquil	33	29	23	20	25
Proximity to SFU	18	18	24▲	15▼	23▲
Access to amenities/Nesters Market	5	16▲	23▲	24	22
Location (general)	27	22	29▲	26	18▼
Outdoor recreation opportunities	13	14	18	15	18
Views/it's beautiful	19	16	16	14	18
Unique development/sustainable community/ lifestyle	12	8	23▲	12▼	14
It's safe	4	6	12▲	14	13
Close to Elementary School/Daycare	-	2	14▲	14	12
Access to transit (transit pass*)	5	9▲	7	6	8
It's clean	4	6	3▼	3	2
Affordable/investment opportunity	1	1	4▲	3	1
New development/liked condo layout	9	6	4	3	-
Miscellaneous	1	2	-	1	2
Not stated	6	3	5	12▲	5▼

*(*transit pass only mentioned prior to 2012)*
Q.A2) What in particular do you like about living at UniverCity?

Figure 3. Life at UniverCity: Likes (Mustel Group and SFU Community Trust, 2010, p. 12).

2.2.4. Post-Occupancy Evaluation of False Creek North – Vancouver, Canada

In 2008, a comprehensive Post-Occupancy Evaluation has been carried out in the master planned community of False Creek North (FCN in Vancouver. The research was conducted as

part of graduate planning course and research program at the School of Community and Regional Planning at the University of British Columbia. The intent was to evaluate how well an example of high-density, mixed-use, family oriented housing development was meeting the needs of its residents:

> This research addresses the planning approach to housing residents from a comprehensive perspective by looking beyond just the individual residential units and housing component of the development to the entire range of support services and amenities that make a community a 'home'. (Hofer, 2008, p. i)

Eight research topic areas were explored in this evaluation: 1) Parks and Public Open Spaces; 2) Shops, Services and Community Amenities; 3) Mobility and Transportation; 4) Community Safety; 5) The Residential Building; 6) The Housing Unit; 7) Sense of Community; 8) Perceived Sustainability of the Neighbourhood (Hofer, 2008).

A comprehensive methodology was developed for the Post-Occupancy Evaluation, which involved twenty-four students over a period of eighteen months:

> The following mixed-methods were employed to reinforce the credibility of the data and interpretation and to construct a more complete picture of the state of the neighbourhood: Mail-out survey questionnaire; Community SpeakOut event: "Have YOUR Say!" day; In-depth interviews; World Café focus group discussion; Photo-collage exercise with elementary students. (Hofer, 2008, p. i)

Overall, the findings from the survey were very positive:

> The key findings show that residents reported high levels of satisfaction in nearly all topic areas; 96% of questionnaire respondents stated that they would recommend living in FCN. A wide range of factors influenced residents' decisions to move to False Creek North most notably being proximity to work, public and private amenities and "livable" urban lifestyle. Residents reported mixed ratings on the "sense of community" with clusters of the community – dog owners, strata members, parents and children – in particular feeling a relatively strong sense of community, and other residents reporting that there the sense of community was largely superficial and many did not have friends in the neighbourhood. (…) Residents, including children, praise the walkability of the community which is possible because of the range of community amenities and commercial services nearby, but two-thirds of residents reported walking beyond a 10 minute walk to meet their day to day needs and also using a car to access more affordable and a wider range of goods. Ninety percent of the sample reported owning at least one car. (…) Concerns about community safety were not reported to be a major problem in FCN. Respondents generally felt very safe in both indoor and outdoor space in FCN, and only slightly less safe at night time. This was reported for participants regardless of gender, age or having a family or not. Social activities and neighbourliness confer the benefits of "eyes on the street" which is well recognized by the residents as being the foundation of the community's security. (Hofer, 2008, p. i)

The survey also included questions about residential buildings and units:

> Buildings received generally high, although also mixed ratings with a number of areas identified for improvement: visitor parking, number of elevators, insufficient and uncreative use of building space for storage space and generally underused indoor and outdoor amenities. Families rated their overall satisfaction with their building lower than residents without children. Unit satisfaction levels also varied widely, but respondents were generally satisfied with their overall unit. Elements of the unit that could be improved include: insufficient general in-suite storage space, insufficient specific storage spaces such as kitchen cabinets and drawers, linen closets and bedroom closets, insufficient and/or inflexible unit space, balcony/outdoor space, kitchens and additional bedrooms. Families with children are equally satisfied with the overall layout of their suite, but express dissatisfaction with the size of their unit and particular rooms, such as kitchens. Sustainability was considered as being important or very important to half of the interview participants with most participants preferring not to use air conditioning to cool their warm apartments and supporting increased energy efficiency of appliances and building systems. (Hofer, 2008, p. ii)

This POE is one of the most comprehensive assessments done at the neighbourhood scale, the process and methodology are available online and have made it a good reference for subsequent research studies.

2.2.5. Assessing neighbourhood liveability: evidence from LEED® for Neighbourhood Development and New Urbanist Communities – USA and Canada

Szibbo has investigated liveability in four North American neighbourhoods: two certified LEED® Neighbourhood Developments and two suburban New Urbanism cases, aiming to provide a series of recommendations for the rating system based on key survey findings.

> LEED® for Neighborhood Development has been rapidly adopted as the de-facto green neighborhood standard and is now used to measure the sustainability of neighborhood design in North America and around the world. Similar to previous LEED® green building rating systems, LEED®ND is heavily reliant on physical & environmental design criteria (such as compact urban form and transit accessibility), and is based on an expert-generated point system. LEED®ND excels at measuring 'environmental sustainability' through its stringent criteria; however, it fails to critically address important livability factors, namely socio-cultural and socio-economic factors. Furthermore, no study has critically examined how LEED®ND could better incorporate these missing factors through post-occupancy analysis. In fact, very little research at all has been done that examines the role of livability and social sustainability in LEED-ND neighborhoods. (Szibbo, 2016, p. 1)

The methodology included a mail survey sent to 500 households in each neighbourhoods, with, with 2,000 surveys mailed out in total:

(…) A mail-out mail-back survey in the Spring of 2013 asked the residents in each community to rank 19 different livability factors that are commonly agreed upon in the planning literature. In Fall 2013 and Spring 2014, I analyzed the survey results and produced several key findings and lessons learned from this case study research. (…) The above data suggests that all four neighborhoods are not particularly diverse in terms of race and socio-economic status. This evidence suggests that LEED®ND neighborhoods could be in danger of following a similar trajectory to New Urbanist neighborhoods, which have been proven in many cases to exemplify sociodemographic homogeneity.

Despite the fact that LEED®ND neighborhoods attempt to promote sustainable modes of transit, findings from my research revealed that the majority of respondents in both the LEED®ND and the New Urbanist case studies believe that owning a vehicle is important, and the majority of respondents in all four neighborhoods owned one or more vehicles. I also found that affordability is a major concern for current residents in both the LEED®ND neighborhoods and the New Urbanist neighborhoods. The survey results illustrated that the majority of respondents in all case study neighborhoods believe that the cost of housing in their neighborhoods impacts the livability of their neighborhood. (Szibbo, 2016, p. 16)

This realisation confirms the fact that there are factors that depend on residents' engagement, which are beyond what is defined in the design and construction stages. There are also other important aspects not covered in these standards.

The survey results also illustrated that suburban respondents highly ranked other factors not currently present in the LEED-ND rating system, such as 'privacy within the interior of the unit,' 'a view to trees and natural landscapes,' and 'a sense of community with neighbours.' The latter two, a view of nature and sense of community with neighbours, are particular to the suburban sites, and may thus potentially indicate what features, both social and environmental, could be improved upon to entice people to live in higher density development in more urban environments. The findings from this post-occupancy evaluation indicate that the incorporation of green infrastructure and design elements in high-density developments has the potential to fulfil both aesthetic and health needs for residents. In addition, architecture that leverages courtyards, rooftops, balconies, and other semi-private open space may be critical for the success of high-density urban neighbourhoods (Szibbo, 2016, p. 19).

2.2.6. Emerging narratives of a sustainable urban neighbourhood: the case of Vancouver's Olympic Village – Vancouver, Canada

Westerhoff has investigated the environmental performance of the Olympic Village in Vancouver:

> Vancouver's Olympic Village neighbourhood has been credited with playing an important role in shifting the city towards a more comprehensive approach to sustainability. Like many other urban sustainability efforts at the neighbourhood scale, however, little is known as to the actual performance of the neighbourhood from the perspective of its occupants. To help fill this gap, I present a framework for the evaluation of the performance of sustainable neighbourhoods that combines insights from narrative and social practice theories to explore how certain narratives of sustainable living are created, translated into practice, and play out in the lives of the principal constituents they affect. In doing so, I begin to reveal the qualitatively felt, experiential dimensions of being in this new form of development, with important lessons for the design, construction and management of future sustainable neighbourhood projects. The study shows that a narrative of liveability and the consideration of short-term quality of life benefits is central to the achievement of ecological and emissions goals. However, an in-depth consideration of the needs of lower income populations is necessary to ensure that the benefits of sustainable living are distributed evenly across socio-economic tiers. (Westerhoff, 2016, p. 1)

When asked about their favourite features in the neighbourhood, the top two were "proximity to amenities" and "quality of public space". This has resulted in changes to residents' lifestyle and health:

> Many residents found that the Village's network of bike and walking paths, transit connectivity and even the local availability of car share options had facilitated a shift in their mobility practices towards options that many felt were healthier, more "environmentally-friendly" and also more enjoyable. (Westerhoff, 2016, p. 11)

Overall, the methodologies used internationally for the Post Occupancy Evaluation of neighbourhoods are diverse. The methods and questions asked are different in each example, depending on regional context, size of neighbourhood, intent of the research, however, it is worth mentioning that most of the examples have focused on qualitative assessments only. As mentioned previously, the concept of POE is rooted in the combination of analysing both quantitative and qualitative aspects. Given the complexity of scale of POEs in neighbourhoods, it can be understood that studies have to be selective in terms of what is evaluated; however, this is certainly an aspect to be improved for the future.

2.2.7. Life satisfaction of downtown high-rise vs. suburban low-rise living – Chicago, USA

In 2017, Du et al. have reported the results of a survey in Chicago with the intent of comparing residents' satisfaction in urban versus suburban contexts:

> There has been a long-standing debate about whether urban living is more or less sustainable than suburban living, and quality of life (QoL) is one of several key measures of the social sustainability of residential living. However, to our knowledge, no study to date has examined life satisfaction among residents of downtown high-rise living compared to residents living in suburban low-rise housing. Further, very few studies have utilized building or neighborhood-scale data sets to evaluate residents' life satisfaction, and even fewer have controlled for both individual and household-level variables such as gender, age, household size, annual income, and length of residence, to evaluate residents' life satisfaction across different living scenarios. (Du, Wood, Ditchman, & Stephens, 2017, p. 1)

The survey method was an online survey created using SurveyGizmo that took approximately 20 minutes to complete, resulting in over 500 responses:

> Therefore, the goal of this study was to investigate residents' satisfaction with their place of residence as well as overall life in general via surveys of individuals living in existing high-rise residential buildings in downtown Chicago, IL, and in existing low-rise residential buildings in suburban Oak Park, IL. Over 1500 individuals were contacted directly, resulting in over 500 responses. The number of fully completed responses for this study was 177, including 94 from residents of four downtown high-rise buildings and 83 from residents in suburban low-rise homes. Residents living in downtown high-rise buildings had significantly higher life satisfaction scores than residents living in suburban low-rise homes when controlling for demographic differences; however, the differences were small, as housing type explained less than 5% of the observed variance in life satisfaction outcomes. The research also evaluated five life satisfaction domains including travel, accessibility, social interaction, safety, and overall residential environment (ORE). In all cases, residents of the downtown high-rises reported higher satisfaction levels, although the scores on all these five satisfaction domains reported from both urban scenarios were very high. Moreover, all five satisfaction domains were highly associated with each other, and accessibility and safety were found as the strongest predictors of ORE for individuals. (Du, Wood, Ditchman, & Stephens, 2017, p. 1)

The results are relevant in showing that higher density, where provided with quality transport and public space for example, can result in higher quality of life and overall life satisfaction.

2.2.8. Star Communities – USA

The Star Communities initiative makes data about cities available online, enabling comparisons between neighbourhoods, cities and counties according to each indicator:

> The Leading STAR Community Indicators include 21 metrics based on the proven STAR Community Rating System. Developed in partnership with the Urban Sustainability Directors Network, the Leading Indicators are organized into an online platform where U.S. cities and counties can annually report key sustainability metrics. Communities of all sizes and experience can use the Leading Indicators to benchmark annual performance and compare their progress with participating communities. (Star Communities, 2017)

A total of 67 communities across the U.S. have become STAR-Certified since 2013. Figure 4 shows the map of the cities which have data available on the annual reporting platform.

Figure 4. Star Communities: Participating Locations (Star Communities, 2017).

Overall, the presented examples utilise multiple methodologies. There is no standard methodology for conducting POE in neighbourhoods; therefore, many of the presented examples tend to focus in one type of assessment, lacking either the quantitative or qualitative component. The objective of these POEs also differs between the examples: some of them were commissioned by local governments, some for university research, some of them commissioned by the developers themselves to ensure the quality of their projects.

One aspect that stands out from the evaluations is the objective of comparing higher density and lower density contexts, as there is continuous discussion in the urban design

field about ideal density to ensure sustainability and liveability. From the examples presented, density itself was often not an issue, but other issues such as lack of green space, inefficient transportation strategies, lack of privacy, etc. This highlights the importance of these evaluations and the possibility of making improvements according to the results.

3. Post-Occupancy Evaluation of Neighbourhoods in New Zealand

There is a limited number of Post-Occupancy Evaluations carried out in New Zealand neighbourhoods. The main examples will be presented in this section.

3.1. Ministry for the Environment: medium-density housing case studies

In 2011, the Ministry for the Environment has commissioned a study on Medium-density housing in New Zealand. This type of development was being constructed in large number and was a relatively new design type, which required high urban design qualities to gain wider community approval. The objectives of the Medium-density housing project were to develop a set of medium-density housing building typologies and to create a medium-density housing assessment methodology, which can help identify particular strengths and weaknesses of developments. For this study, medium density was defined as follows:

> multi-unit developments with an average site area density of less than 350 m^2 per unit. It can include detached (or stand-alone), semi-detached (or duplex), terraced or low rise apartments on either single sites or aggregated sites, or as part of larger masterplanned developments. (Boffa Miskell Ltd, 2012, p. 2)

It was envisioned that this methodology, with refinement, could be used to enhance the design of future developments. As part of this project, case studies were carried out which included Post-Occupancy Evaluation. Three neighbourhoods were selected as case studies: Stonefields in Auckland, The Altair in Wellington and Chester Courts in Christchurch (Boffa Miskell Ltd, 2012).

3.1.1. Stonefields, Auckland

The Post-Occupancy Evaluation in Stonefields included 39 surveys sent out to residents, from which 18 were returned with answers.

> Returned residents' surveys of the case study area indicate general satisfaction with the location, the look and feel of the development as a whole, and of their block in particular. On questions relating to the site context, 100 per cent of residents rated the look and feel of their street as good or very good, 89 per cent of residents rated the look and feel of

Stonefields as good or very good, with the remaining 11 per cent rating this as average. The main criticism residents had on the location and site context is that until the shops within the development are opened, local shops are more than a short walk away. Bluestone Park has a range of facilities including play equipment, dog water, and picnic tables. Due to this, residents surveyed indicated a high level of satisfaction with the provision of communal facilities; 89 per cent rating this good or very good. (Mein, 2012, p. 12).

Overall, residents were satisfied with the local amenities. The main downside was related to the transitional stage of the development, where not all amenities and shops have been finalised at the time of the survey. This is a common issue, and it would be beneficial to evaluate the neighbourhood again at the time of completion of the whole development.

Maintenance of common areas was rated highly; 78 per cent rating this as good or very good. However, one respondent commented on individuals taking responsibility for mowing the berms, suggesting a mixed view on who maintains common areas. While most respondents noted individuals maintain their own parts, many added that the developer and the Council maintain the parks. People are satisfied with the quantity of car parking spaces; 78 per cent rated these as good or very good. However, one resident observed that stacked car parking in the garages means people park their second car on the street thereby reducing on-street parking for visitors. The respondents indicate a high level of satisfaction with their building form and appearance. Overall there was a high level of satisfaction amongst residents about their home. The residents in the stand-alone houses were very satisfied and rated all criteria as good or very good. Some of the residents, in the rear access terrace houses along Briody Terrace, appeared slightly less satisfied with the level of visual privacy, the quality and usability of private open space, and the quality and size of external service areas. Approximately three-quarters of respondents rated ventilation of the home in summer months and protection from noise between them and neighbours good or very good. Residents commented on how they enjoy the development because it is new and fresh, close to amenities including the new primary school, the neighbours are friendly and a sense of community is forming. (Mein, 2012, p. 13)

The results confirm an overall satisfaction with this medium density development. However, this POE did not include questions about many aspects that influence the neighbourhood quality, such as active and public transport, safety, affordability, among other themes.

3.1.2. The Altair, Wellington

The Altair development consists of 58 units completed in 2006, close to Newtown Town Centre in Wellington. The survey was responded to by 30 per cent of the dwellings. The majority of the residents have been in Altair for less than two years; their age group is mainly between 25 and 45 years old, followed bu the 16 to 24 age group. There are a small

number of families with young children living in Altair, the majority of households are occupied by unrelated persons with an average of three to four people per household. In regards to tenure, there is a mix: half of respondents own their unit and the other half are in private rental agreements (Ferreira, 2012). The main positive aspects found in the survey were the following:

> The respondents are quite satisfied with their living environment, especially in regard to the close proximity to community amenities. Other positive aspects are: low maintenance, a safe environment, modern design, variation in the façade treatment, architectural distinction between blocks, good internal layout, dryness, natural sunlight, ventilation and insulation of the units, and protection from traffic noise and noise between units. (Ferreira, 2012, p. 13)

Negative aspects were also mentioned by the residents:

> People are mostly dissatisfied with the provision of service areas and spaces for bicycles and motorcycles. A good proportion of respondents suggested the provision of communal rubbish disposal areas. The lack of privacy, especially in the private open spaces, also came through as a key aspect to be improved. Some respondents indicated difficulties of external people (taxis, visitors or postman) finding the main entry doors. There is a mix of opinion about the provision of car parking, difficulties with access and manoeuvre, storage areas, and communal open spaces. (Ferreira, 2012, p. 13)

Questions about vehicle parking and communal spaces have resulted in a mix of responses:

> Some of the respondents are satisfied with the quantity of car space provided (44 per cent) and others dissatisfied (37 per cent). The research cannot conclude if there is a relationship between tenancies, parking provision and number of occupancies, and the requirement for more car parking. This seems to be a personal choice.

> Residents are happy with the communal open spaces provided but just over half of the respondents believe it could be improved. A few respondents suggested a wider staircase within the units would facilitate furniture removal. The majority of respondents rated 'average' to 'very poor' the ability to personalise their homes and the usability of their private open spaces. Respondents also suggested that double glazed windows, heat pumps and longer-lasting materials would benefit the design. A few respondents dislike the restrictive body corporate rules. (Ferreira, 2012, p. 13)

3.1.3. Chester Courts, Christchurch

The development of Chester Courts is a terrace housing complex of 15 units, located on the north-eastern side of central Christchurch. This limited number of units means a smaller number of questionnaires responded to, with only four residents completing the survey (27

percent of the total) (Church, 2012). The following summarises the findings from the post-occupancy evaluation:

> the development has a mix of ages, including a family and retired couples. All owned their units and had been living in the development more than 12 months with at least two having lived there five years or more. All owned only one car, but indicated that residents in other units had more and this was often hard to manage. Those residents who responded thought the development was good to very good. Areas where the development rated most highly was its neighbourhood context (i.e., proximity to community facilities and local street environment) and the design of their home (i.e., internal layout, access to sunlight, ventilation and open space). Other notable results were the consistent good ratings for the maintenance of the common areas and the ability to manoeuvre vehicles around the development. Parts of the development which were considered by residents to perform less well were the provision of communal facilities (e.g., barbeque areas and play facilities), amount of bike parking, and noise between their home and other neighbouring units. Interestingly, respondents in the front terraces felt they could personalise their space more and visual privacy was better than respondents in the rear terraces. (Church, 2012, p. 11)

Overall, the Medium Density case studies by the Ministry for the Environment are a relevant example of POE in New Zealand funded by the government. Such initiative was meant to guide future planning of neighbourhoods, and it does provide important feedback from residents about common urban design and architecture features of medium-density developments.

3.2. Beacon Pathway: the Neighbourhood Sustainability Framework

In 2008, Beacon Pathway developed a series of studies in regards to neighbourhood sustainability evaluation in New Zealand. The Neighbourhood Sustainability Framework was developed to assess existing communities, as explained in Section 3.1 of this literature review. The framework aims to provide integration of the environmental, social and economic elements of neighbourhoods around six critical domains for neighbourhood sustainability: Functional flexibility, Neighbourhood satisfaction, Minimised costs, Maximised biophysical health, Appropriate resource use & climate protection, Effective governance & civic life (Figure 5).

The development of this framework was integrated the National Survey of Neighbourhood Experiences and Characteristics, which will be discussed in this section. The framework has been applied to different neighbourhoods in New Zealand in order to assess

neighbourhoods in relation to those domains and to identify key adaptations of existing neighbourhoods and amendments to the design of new neighbourhoods to improve their sustainability (Saville-Smith, 2008).
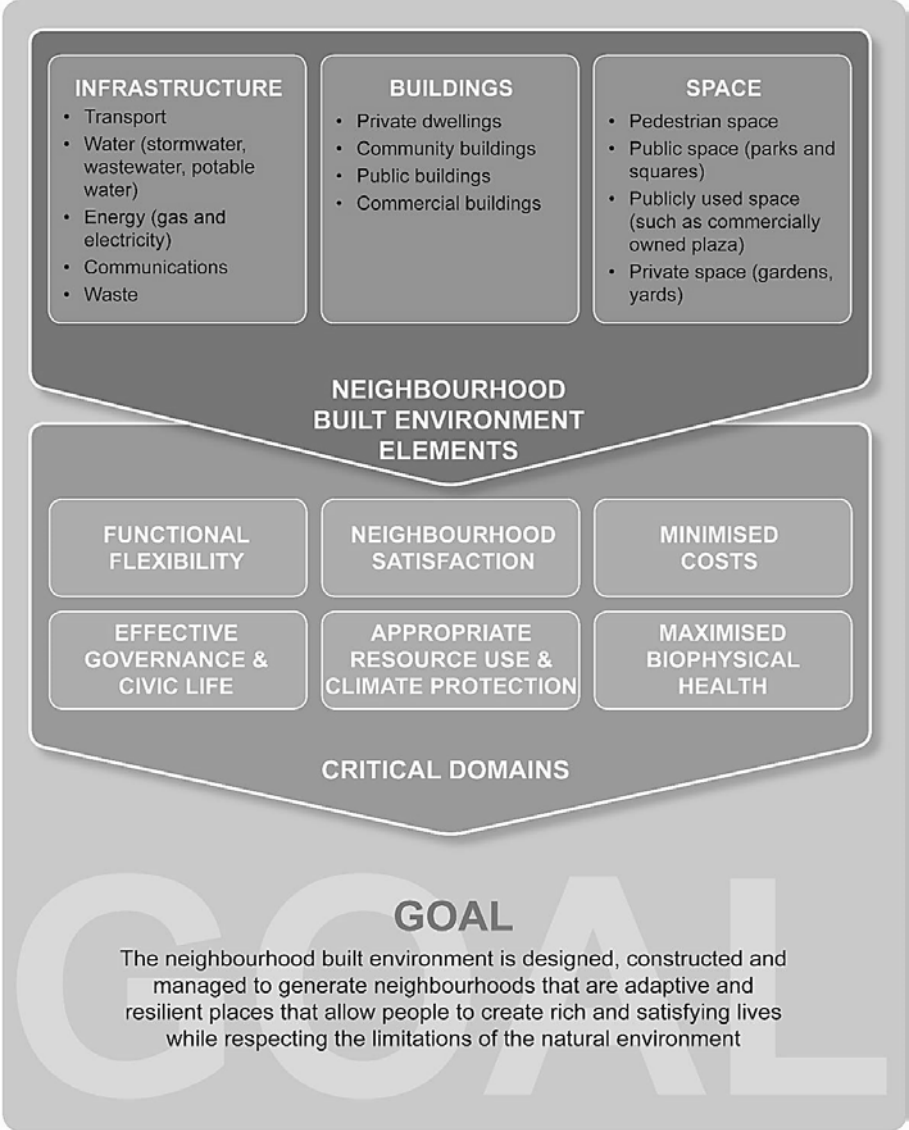

Figure 5. Goals, critical domains and elements for sustainable neighbourhoods (Saville-Smith, 2008, p. 9).

Since the development of the Neighbourhood Sustainability Framework in 2008, these assessment tools have been applied to several communities in New Zealand:

- Hobsonville Point, Auckland
- Harbour View, Auckland
- Petone, Hutt City
- Blake St, Ponsonby, Auckland

- East Inner City, Christchurch

- Aranui, Christchurch

- Dannemora, Auckland

- Waimanu Bay, Auckland

- West Harbour, Auckland

- Addison, Auckland

The evaluation of these neighbourhoods has provided useful feedback: Master plan developers were able to assess how their developments were progressing over time and to trouble shoot any issues the community is raising; local boards got community feedback on areas which are successful or which need work, in order to inform planning. Results from Hobsonville Point will be discussed later in this section, as this community will be the case study for the next stages of this research.

3.2.1. National Survey of Neighbourhood Experiences and Characteristics

In 2008, Beacon Pathway has undertaken a survey of 1,613 people in New Zealand around their behaviours, perceptions and experiences in relation to their neighbourhoods. The survey aimed to provide direct evidence as to the impact of built environment densities and use profiles on aspects of neighbourhood environmental performance. The survey was undertaken to provide a baseline for Beacon's Neighbourhood Sustainability Resident Self-Report Tool (Saville-Smith, 2008).

A company specialising in telephone survey was commissioned to undertake telephone surveying using a slightly amended questionnaire to align to the requirements of the Computer Assisted Telephone Interviewing (CATI) system used by that company for interviewing. The following key findings about residents' perceptions were identified through the survey:

- Most (63.6 percent) householders have no intention to move in the next few years.
- Intention to move because of home or dwelling problems are most evident in high and medium density mixed use neighbourhoods and low density non-mixed use neighbourhoods.
- Intention to move because of neighbourhood dissatisfaction is small (2.9 percent overall) but most pronounced in medium density mixed-use neighbourhoods.
- Density and mix both impact on travel mode and the average kilometres travelled by private car in a four week period.

• Householders living in high density mixed use are most likely to have positive feelings about safety.

• High density mixed use and medium density mixed use householders were more likely to see noise as a serious problem.

• Irrespective of density or use characteristics, 79 percent of householders know some people in their neighbourhood. Only 3.9 percent reported knowing no one. There is little different in relation to propensity to greet and chat with neighbours.

• High density mixed use and medium density mixed use households are least likely to find neighbourhoods friendly and they are less likely to have a sense of attachment to the neighbourhood. (Saville-Smith, 2010, p. 5).

3.2.2. Applying the Neighbourhood Sustainability Tools to Hobsonville Point

In 2013, Beacon Pathway carried out a comprehensive evaluation of Buckley Precinct in Hobsonville Point, part of a scheduled assessment of sustainable development by the Hobsonville Land Company. The Neighbourhood Sustainability Framework was applied, including the Observational Tool and Resident Survey Tool. The findings were reported by Bijoux:

> Results show that, despite only being occupied recently, Buckley Precinct is already performing strongly with respect to the design, construction and management of the local built environment. The results also show that performance generates places that allow people to create rich and satisfying lives while respecting the limitations of the natural environment. (Bijoux, 2013, p. ii)

The Observational Tool was applied by Denise Bijoux (Beacon) in conjunction with Katja Lietz (Hobsonville Land Company). The process involved both desktop and on site observations in July 2013. According to this tool, the following areas were rated with a high standard of sustainability.

	Current rating	Key areas of strength
Walking access to basic everyday facilities	Very High	Multiple facilities within easy walking distance.
Protection and enhancement of the natural environment	Very High	Concentration of imperviousness as well as planting and protection of habitat, stream and wetland management (including riparian margins).
Dwelling Sustainability	Very High	High standards of energy efficiency, the inclusion of renewable energy sources, effective water efficiency and options for natural ventilation for all rooms.
Quality of space	Very High	Good passive surveillance of and effective ease of access to footpaths and public spaces, opportunities for casual interaction and high quality streetscapes and public spaces.
Street network	Very High	Responds well to natural features, offers reasonable solar access for most dwellings, providing good connectivity and discouraging fast traffic.

Figure 6. Sections that rate strongly (Bijoux, 2013, p. 11).

The Observational Tool has also identified aspects that can be improved.

	Current rating	Areas for improvement
Access to public transport	Medium	Improving the frequency of public transport and improved public transport routes.
Efficient use of space and viability of local centres	Medium	Increasing the presence of local facilities, such as retail shops and a higher density of dwellings in the immediate vicinity of these.
Diversity and resilience	High	Increasing the mix of uses in the neighbourhood and immediate environment. For example, providing healthcare, child care or professional (legal or accounting) services, start-up spaces for artists or commercial enterprises and/or live/work premises.
Innovation and community building	Medium	Increasing community building activities such as a toy library or men's shed as well as communal energy generation or car sharing for example.

Figure 7. Sections with potential for improvement (Bijoux, 2013, p. 11).

The Resident Survey Tool included a total of 65 households (over 83 per cent of the total number of households), with most surveys (47) received via the survey team who went door

to door and 18 surveys self-completed and left in the box at the local café. The survey has found the following about transport:

> In terms of transport, by far the majority of residents travel to work or education as the driver of a motor vehicle (61.4 per cent). As Figure 8 shows, these drivers are often accompanied by passenger (accounting for a further 22.8 per cent). Motor vehicle transport therefore makes up 84.2 per cent of journeys to work or education. Of the remainder, 7.1 per cent took the bus and 4.3 per cent took the ferry, while 3.1 per cent walked and 1.1 per cent cycled. (Bijoux, 2013, p. 24)

The main positive aspects about the community were the following:

> People frequently mention their pleasure in living close to the water and their appreciation of local walks and amenities including schools, the park and playground, Catalina café, the farmers market and the ferry service. Respondents also enjoy being within relatively easy access of main centres, places of work and the motorway and some were excited to be part of an evolving and "well laid out" neighbourhood. (Bijoux, 2013, p. 24)

Some negative aspects about Hobsonville point were also mentioned by residents:

> While several people took the time to say that there was nothing they did not like, others disliked the lack of local retail spaces, evening meeting places, a petrol station and a supermarket. They also disliked the limited public transport timetables and the distances they had to travel by car, often at peak times. Several also disliked the limited parking nearby and how parking by-laws regarding community parking are not always complied with. Others found living in a construction zone disruptive and reported some construction workers as less than courteous. Narrow streets, intrusive "weekend tourists" and limited options for "telco services" were also mentioned by more than one person. (Bijoux, 2013, p. 24)

This assessment is a valuable reference, as the case study of this research will be the same neighbourhood of Hobsonville Point, re-evaluating the same community four years after the survey conducted by Beacon Pathway. The area has experience intense development since the survey was undertaken, therefore this will provide an important comparison of the performance of the neighbourhood.

Overall, Beacon Pathway's research about New Zealand neighbourhoods provides comprehensive data both quantitatively and qualitatively. The questionnaires are clear and easy for residents to answer. The Observational Tool, however, could benefit from more objective criteria, as many of the aspects evaluated rely on subjective evaluations by professionals, which might generate distinct assessments based on personal judgement.

4. Conclusions

This literature review has presented the state of the art on Post-Occupancy Evaluation of neighbourhoods. The examples and methodologies for the application of POE in the neighbourhood scale are still limited both internationally and in the New Zealand context. Although a few neighbourhood POEs can be found in the literature, they are usually restricted in terms of scope. Given the complexity of neighbourhood evaluation, studies usually focus only on a few aspects, or only on one type of assessment i.e. qualitative or quantitative.

It was found that the results from examples of POEs can often be unexpected; with the lack of real performance data, many design assumptions can usually be found to be inaccurate. There is also a need for developing holistic approaches that combine the evaluation of overall sustainable performance as well as neighbourhood liveability.

The methods for the collection of data are multiple: some examples have used mail questionnaires, others were done via telephone, and more recent examples have been completed with online surveys. The size of the datasets suggests online surveys can be an effective way of applying questionnaires. In addition, data collection linked to GIS software was identified as a promising technology for the Post-Occupancy Evaluation of neighbourhoods. The possibilities of geo referencing the evaluations are important, as this can organise data in the form of maps and help understand the weaknesses and strengths of each specific location within the neighbourhood.

Post-Occupancy Evaluation of neighbourhoods is a relevant tool in the New Zealand context, as cities are trying to increase density without compromising liveability. POEs in New Zealand neighbourhoods are important for the international context because of the diverse ethnic and cultural context of the country, making it possible to evaluate how different cultures experience and engage in their neighbourhoods. Evaluations in the New Zealand context can be informed by international experiences, as the examples presented can contribute to the local context. Especially the experiences shown in the United States (Star Communities) and Italy (Urban Ecosystem) to make data available about the

performance of communities and cities are very relevant, as they encourage local leadership to make constant improvements to achieve better ratings.

Based on existing examples and standards, the proposed framework aims to aid in the development of a comprehensive quantitative and qualitative evaluation for the neighbourhood scale. The proposed indicators and questionnaire given in the Appendixes can be used as guidelines for future research and for the case study that will be carried out as part of the National Science Challenge.

5. APPENDIX 1: Comparison between existing assessment schemes for neighbourhoods

Comparison: LEED®-ND, BREEAM® Communities, Greenstar Communities and Beacon Pathway Neighbourhood Sustainability Framework (NSF)			
1. Energy Use & Greenhouse Gas (Transportation & Land Use)			
Scale: District & Neighbourhood			
Topic	**Certification Scheme**	**Credit**	**Summary of requirements**
1.20 Robust Pedestrian Networks: Small & Defined Blocks; High Network Connectivity	LEED-ND	NPD CREDIT: CONNECTED AND OPEN COMMUNITY	Locate or design the project such that its internal connectivity falls within one of the ranges listed: intersections per square kilometre 116-154 (1 point), >154 (2 points)
	BREEAM Communities	TM 02 – Safe and appealing streets	To create safe and appealing spaces that encourage human interaction and a positive sense of place. Development of a movement framework, considering the form of the surrounding environment (buildings, landscape and activities) connection and permeability of street networks.
	Greenstar Communities	02. Design Review	Development of a street network and block lengths that are safe and efficient and encourage walking to public transport.
	Beacon Pathway NSF	Observational Tool: Appropriate street network	Street network evaluation: A mixture of measurement and professional judgement within tight guidelines (Observational Tool)
1.21 High Density Zoning & Platting	LEED-ND	NPD PREREQUISITE: COMPACT DEVELOPMENT	Design and build the project to meet the densities specified. Projects with Access to Quality Transit: for residential components located within the walking distances: 12 or more dwelling units per acre; for residential components falling outside the walking distances: 7 or more dwelling units per acre
	BREEAM Communities	GO 03 – Design review	To ensure that the masterplan's design supports a vibrant, healthy, functional and inclusive development. A community engagement process led by an independent facilitator is used to inform how the development addresses density, scale and appearance. (No specific numbers or incentives for increased density are mentioned)
	Greenstar Communities	02. Design Review	Identify a target density that supports the planned facilities and activities including the provision, extension or enhancement of public transport infrastructure.; Increase residential densities in suitable locations proximate to activity centres and high frequency public transport stations / stops.
	Beacon Pathway NSF	Observational Tool: Efficient use of space and viability of local centres	Residential density of the development assessed through measured credits

Topic	Certification Scheme	Credit	Requirements
1.22 Macro Parking Management & Design	LEED-ND	LT CREDIT: REDUCED PARKING FOOTPRINT	For multi-unit residential, either do not build new off-street parking lots, or locate all new off-street surface parking lots at the side or rear, leaving building frontages facing the circulation free of surface parking lots (alleys may be exempted). Use no more than 20% of the total development footprint area for all new off-street surface parking, with no individual surface parking lot larger than 0.8 hectare.
	BREEAM Communities	SE 12 – Local parking	To ensure parking is appropriate for the expected users and well integrated into the development. Minimum: Consultation with local authorities, developer, community representatives and other stakeholders. One credit: Parking is integrated into the development without allowing it to dominate the space or interfere with cyclist, pedestrian and motor vehicle movement; residential parking is located behind, under, above or to the side as opposed to within the front curtilage; Residential parking is overlooked by houses
	Greenstar Communities	-	N/A
	Beacon Pathway NSF	-	N/A
1.23 High Micro Scale Land Use Mix	LEED-ND	NPD CREDIT: MIXED-USE NEIGHBORHOODS	Locate or design the project such that 50% of its dwelling units are within 400m walking distance of a number of diverse uses - points awarded according to number of different uses, from 4 to 20 uses.
	BREEAM Communities	SE 02 – Demographic needs and priorities	To ensure that the development plans for the provision of housing, services, facilities and amenities on the basis of local demographic trends and priorities.
	Greenstar Communities	13. WALKABLE ACCESS TO AMENITIES	All habitable buildings on the project site have walkable access to at least two different classes of amenities, within the following maximum radius to all habitable buildings: Primary Services and Facilities - 400m; Secondary Services and Facilities - 800m
	Beacon Pathway NSF	Item A - Observational Tool / Question 6 - Resident Survey Tool	Observational tool: Evaluate walking to basic every-day facilities (schools, reserves, shops). Resident Survey: How often do ANY members of your household visit or use these local places? - Local shops, cafes, parks/reserves/beach, playgrounds, school/preschool, heritage sites
Scale: Block & Street			
Topic	**Certification Scheme**	**Credit**	**Requirements**
1.30 Multimodal Street Design: 1.301 Walkable Streets	LEED-ND	NPD PREREQUISITE: WALKABLE STREETS	Continuous sidewalks are provided along both sides of 90% of the circulation network block length within the project. New sidewalks must be at least 2.5 m wide on retail or mixed-use blocks and at least 1.2 m wide on all other blocks. No more than 20% of the block length of the circulation network is faced directly by garage and service openings. Alleys may be omitted from the calculations.
	BREEAM Communities	TM 02 – Safe and appealing streets	To create safe and appealing spaces that encourage human interaction and a positive sense of place.

			Incorporate the following: all streets and open spaces will be overlooked by multiple dwellings; all access points and routes through the site will be well lit, direct and overlooked; pedestrian crossings are designed to ensure safety for all users
	Greenstar Communities	09. HEALTHY AND ACTIVE LIVING	Minimum Requirement - Footpaths: projects must provide footpaths in line with the project's street hierarchy. In NZ, projects should follow NZS 4404:2010
	Beacon Pathway NSF	Question 3 - Resident Survey Tool	For each person, please tell us the main way they usually travel to work or education. If more than one travel option is used (e.g. walk then bus), then tell us the one that is used for the longest part of the journey.
1.30 Multimodal Street Design: 1.302 Robust Bicycle Infrastructure	LEED-ND	LT CREDIT: BICYCLE FACILITIES	Locate the project such that the project boundary is within 400m bicycling distance of an existing bicycle network; or Design the project such that at least 50% of dwelling units and nonresidential use entrances are located on an existing or planned bicycle network extending at least 3 continuous miles
	BREEAM Communities	TM 03 – Cycling network	Provide a safe and efficient cycle network. Cycle routes in the development connect to, or are a continuation of existing routes from the surrounding area, connecting residential areas to community focal points; routes are direct and safe (well lit, safe road crossings etc.); segregated from vehicles and pedestrians as appropriate; Adequate signage detailing directions and route information is provided; Special provision is provided at junctions; Cycle routes are attractive and designed to be enjoyable.
	Greenstar Communities	09. HEALTHY AND ACTIVE LIVING	Points are available where the project site has been designed and built to promote an active lifestyle, through well designed walking paths and cyclist facilities.
	Beacon Pathway NSF	Question 3 - Resident Survey Tool	For each person, please tell us the main way they usually travel to work or education. If more than one travel option is used (e.g. walk then bus), then tell us the one that is used for the longest part of the journey.
1.30 Multimodal Street Design: 1.303 Design for Transit	LEED-ND	SLL PREREQUISITE: SMART LOCATION; LT CREDIT: ACCESS TO QUALITY TRANSIT	Locate the project on a site with existing or planned transit service such that at least 50% of building entrances are within a 400m walking distance of at least one bus or streetcar stop, or within a 800m walking distance of at least one bus, streetcar, or rideshare stops or within a 800m walking distance of bus rapid transit stop, light or heavy rail station, commuter rail station, or commuter ferry terminal
	BREEAM Communities	TM 01 – Transport assessment	To ensure transport and movement strategies reduce the impact of the development upon the existing transport infrastructure and improve environmental and social sustainability through transport. Mandatory: transport assessment following scoping discussions with the local authorities; travel plan(s) is developed for the site outlining the design methods used to encourage and implement sustainable transport and movement.
	Greenstar Communities	27. SUSTAINABLE TRANSPORT AND MOVEMENT	To encourage and recognise integrated responses to transport and movement that encourage a people-focused hierarchy. Transport Assessment shall: Create

			efficient pedestrian, bicycle and vehicle linkages internally and connections to surrounding urban development (particularly to and from public transport stops, community services and major traffic generators); Reduce distances from buildings to public transport nodes; and public transport networks including end-of-line facilities; Ensure safe and easy access to workplaces, shopping, leisure facilities and open public places by walking, cycling and public transport; Accommodate and demonstrate consistency with future public transport options/proposals and future growth; and consider transport capacity to ensure there is sufficient provision and flexibility for changes to the transport regime over time.
	Beacon Pathway NSF	Question 3 - Resident Survey Tool	For each person, please tell us the main way they usually travel to work or education. If more than one travel option is used (e.g. walk then bus), then tell us the one that is used for the longest part of the journey.
1.30 Multimodal Street Design; 1.304 Limiting Motor Vehicle Impact	LEED-ND	NPD CREDIT: TRANSPORTATION DEMAND MANAGEMENT	To reduce energy consumption, pollution, and harm to human health from motor vehicles by encouraging multimodal travel. Option 1: Transit Passes; Option 2: Developer-Sponsored Transit; Option 3: Vehicle Sharing; Option 4. Unbundling of Parking and Parking Fees; Option 5: Guaranteed Ride Home Program; Option 6: Flexible Work Arrangements
	BREEAM Communities	RE 07 – Transport carbon emissions; TM 02 – Safe and appealing streets	To reduce pollution associated with car use and provide viable alternatives to car ownership. Travel plans for the development set out the appropriate alternative transport options, i.e. car pools/clubs, cycle hire schemes, lift sharing clubs, community electric vehicle hire, community work / office space – to avoid the need to commute to offices. Targets set regarding road traffic accident reduction; Potential vehicle noise, visual and vibration disturbance has been mitigated through road layout, buildings and buffer zones.
	Greenstar Communities	27. SUSTAINABLE TRANSPORT AND MOVEMENT	Transport Assessment shall: Reduce the dependence on single vehicle transport for travel, by promoting active movement within the community and the use of public transport; Reduce the vehicle kilometres travelled per trip;
	Beacon Pathway NSF	Question 4 & 5 - Resident Survey Tool	How many motor vehicles does your household have? If your household uses one or more vehicles, what is the total kilometres driven by all those vehicles in the last four weeks? A rough estimate is okay.
1.31 Dense & Street Activating Building Typologies	LEED-ND	NPD CREDIT: WALKABLE STREETS	Building façades facing the circulation network in the project is no more than 25 feet (7.5 meters) from the property line; All ground-level retail, service, and trade uses that face a public space have clear glass on at least 60% of their façades between 900 and 2500 millimeters above grade; If a façade extends along a sidewalk, no more than 40% of its length or 15 meters, whichever is less, is blank (without doors or windows).
	BREEAM Communities	SE 07 – Public realm	To encourage social interaction by creating comfortable and vibrant spaces in the public realm. A mix of uses on

			the ground floor (and range of access points to these) throughout the devel-opment encourages a sense of vibrancy through design measures such as: frequent use, activity overspill (e.g. café) to the street, transparent glazing to allow views both out and in.
	Greenstar Communities	15. SAFE PLACES	To recognise projects in which the activity of planning and detailed design for land use, development and redevelopment takes into consideration designing out crime principles. There must be minimal physical or vegetative visual barriers; Fence design must maximise natural surveillance from the street to the building, building to the street and minimise opportunities for intruders to hide.
	Beacon Pathway NSF	Observational Tool & Question 10 - Resident Survey Tool	Professional judgement and/or direct observation to assess if there is good surveillance of public spaces. Question: Thinking about safety, in general how safe or unsafe do you feel in the following situations: Walking in my neighbourhood during the day; Walking alone in my neighbourhood after dark

2. Water

Scale: District & Neighbourhood

Topic	Certification Scheme	Credit	Requirements
2.20 Avoid Flood Prone Areas	LEED-ND	SLL PREREQUISITE: FLOODPLAIN AVOIDANCE	Locate on a site that is entirely outside any flood hazard area; or locate the project on an infill site or a previously developed site and design buildings to prevent flooding
	BREEAM Communities	SE 03 – Flood Risk Assessment	To ensure that sites and developments take due account of flood risk and, where it is present, take appropriate measures to reduce the risk of flooding to the development and the surrounding areas.
	Greenstar Communities	-	N/A
	Beacon Pathway NSF	Observational Tool: Protection and enhancement of the natural environment	Measured credits for Riparian, coastal and wetland management
2.21 Robust Stormwater Management Network (Distributed & On-Site Recharge)	LEED-ND	GIB CREDIT: RAINWATER MANAGEMENT	To reduce runoff volume and improve water quality by replicating the natural hydrology and water balance of the site, based on historical conditions and undeveloped ecosystems in the region.
	BREEAM Communities	SE 13 – Flood risk management	To avoid, reduce and delay the discharge of rainfall to public sewers and watercourses, thereby minimising the risk of localised flooding on and off site, watercourse pollution and other environmental damage.
	Greenstar Communities	24. INTEGRATED WATER CYCLE	Performance Pathway: Potable water consumption is reduced, through the application of the principles of Water Sensitive Urban Design (WSUD), when compared against a reference project. Prescriptive Pathway: demonstrated that the project applies best practice water management practices for alternative water

			sources and stormwater
	Beacon Pathway NSF	Observational Tool: Protection and enhancement of the natural environment	Measured credits for Stormwater management

		Scale: Block & Street		
Topic	**Certification Scheme**	**Credit**	**Requirements**
2.30 High Surface Permeability	LEED-ND	GIB CREDIT: RAINWATER MANAGEMENT	In a manner best replicating natural site hydrology processes, manage on site the runoff from the developed site for the percentile of regional or local rainfall events listed, using low-impact development (LID) and green infrastructure.
	BREEAM Communities	SE 13 – Flood risk management	An appropriately qualified professional is appointed to carry out the calculations and provide design criteria for all elements regarding the surface water run-off drainage system in a report. The peak rate of surface water run-off over the development lifetime, allowing for climate change, is no greater for the developed site than it was for the pre-development site. This should comply at the 1 year and 100 year return period events.
	Greenstar Communities	24. INTEGRATED WATER CYCLE	Performance pathway: demonstrate that the post-development peak Average Recurrence Interval (ARI) event discharge from the project site does not exceed the predevelopment peak ARI event discharge;
	Beacon Pathway NSF	Observational Tool: Protection and enhancement of the natural environment	Measured credits for stormwater management
2.33 Rainwater Capture & Re-use	LEED-ND	GIB CREDIT: RAINWATER MANAGEMENT	To reduce runoff volume and improve water quality by replicating the natural hydrology and water balance of the site, based on historical conditions and undeveloped ecosystems in the region
	BREEAM Communities	LE 06 – Rainwater harvesting	To ensure that surface water run-off space is used effectively to minimise water demand. 5% to 50% of the total hard surface for the site (roof plus hard-standing) is designed to allow the harvesting of rain water for re-use.
	Greenstar Communities	24. INTEGRATED WATER CYCLE	Management of stormwater peak flows may include one or more of the following techniques: Stormwater reuse (including roof collection and use)
	Beacon Pathway NSF	Observational Tool: Protection and enhancement of the natural environment	Measured credits for stormwater management - no specific mention about water re-use
2.34 Water Use Reduction	LEED-ND	GIB PREREQUISITE: INDOOR WATER USE REDUCTION	For new buildings and buildings undergoing major renovations as part of the project, reduce indoor water usage by an average of 20% from a baseline.

Topic	Certification Scheme	Credit	Requirements
	BREEAM Communities	RE 03 - Water strategy	To ensure that the development is designed to minimise water demand through efficiency and appropriate supply-side options taking full account of current and predicted future availability of water in the area.
	Greenstar Communities	24. INTEGRATED WATER CYCLE	Performance pathway: demonstrate that potable water consumption of the project is reduced, through the application of the principles of Water Sensitive Urban Design
	Beacon Pathway NSF	Question 10 - Resident Survey Tool	Do you believe you live in a water efficient home?

3. Ecology & Habitat

Scale: District & Neighbourhood

Topic	Certification Scheme	Credit	Requirements
3.20 Ecological Corridors & Pockets, Restore Waterways	LEED-ND	SLL CREDIT: SITE DESIGN FOR HABITAT OR WETLAND AND WATER BODY CONSERVATION	Case 1 - Sites without Significant Habitat or Wetlands and Water Bodies: Locate the project on a site that does not have significant habitat. Case 2 - Sites with Habitat or Wetlands or Water Bodies: Work with state fish and wildlife agency to delineate identified significant habitat on the site.
	BREEAM Communities	LE 04 – Enhancement of ecological value	To ensure that the ecological value of the development is maximised through enhancement. The masterplan enhances ecological value through the protection, enhancement and/or creation of wildlife corridors on the site linking established and/or new wildlife habitats on or adjacent to the site.
	Greenstar Communities	29. ECOLOGICAL VALUE	A Biodiversity Management Plan has been prepared by a suitably qualified professional and is implemented demonstrating the management of the long term biodiversity values of the project site (and off site values, where offsets are established); It is demonstrated that the Biodiversity Management Plan for the project site will create a net biodiversity gain representing an enhancement over the project's biodiversity at the date of site purchase
	Beacon Pathway NSF	Observational Tool: Protection and enhancement of the natural environment	Measured credits for Protection and creation of habitat; Riparian, coastal and wetland management
3.21 High Urban Forest Continuity & Diversity	LEED-ND	NPD CREDIT: TREE-LINED AND SHADED STREETSCAPES	Provide trees at intervals of no more than 12 m (exempting driveways) along at least 60% of the total existing and planned block length within the project, and on the project side of blocks bordering the project, between the vehicle travel way and walkway. Alleys may be exempted.
	BREEAM Communities	SE 11 – Green infrastructure	To ensure access to high quality space in the natural environment and/or urban green infrastructure for all.
	Greenstar Communities	02. DESIGN REVIEW	Landscape and Green Infrastructure: ensure road reserve design provides for appropriate landscape treatments (including street trees), avoids future infrastructure /

			landscape conflicts, and facilitates active transport modes.
	Beacon Pathway NSF	Observational Tool: Protection and enhancement of the natural environment	Measured credits for Protection and creation of habitat

Scale: Block & Street			
Topic	**Certification Scheme**	**Credit**	**Requirements**
3.31 Micro-Habitat Creation	LEED-ND	SLL Prerequisite: Imperiled Species and Ecological Communities Conservation	Case 1: Sites without Affected Species or Ecological Community. Case 2: Sites with Affected Species or Ecological Community - need to provide a Habitat Conservation Plan
	BREEAM Communities	LE 04 – Enhancement of ecological value	The masterplan enhances ecological value through the creation of appropriate new habitats or through the increase in scale of existing habitats on the site in accordance with the recommendations of the suitably qualified ecologist and appropriate statutory or wildlife bodies.
	Greenstar Communities	29. ECOLOGICAL VALUE	A Biodiversity Management Plan has been prepared by a suitably qualified professional and is implemented demonstrating the management of the long term biodiversity values of the project site (and off site values, where offsets are established); It is demonstrated that the Biodiversity Management Plan for the project site will create a net biodiversity gain representing an enhancement over the project's biodiversity at the date of site purchase
	Beacon Pathway NSF	Observational Tool: Protection and enhancement of the natural environment	Measured credits for Protection and creation of habitat
3.32 Mitigating Habitat Disruption	LEED-ND	SLL CREDIT: PREFERRED LOCATIONS; SLL CREDIT: STEEP SLOPE PROTECTION	To encourage development within existing cities, suburbs, and towns to reduce the environmental and public health consequences of sprawl. To reduce development pressure beyond the limits of existing development. To conserve the natural and financial resources required for infrastructure. Ensure that the share of the development footprint on existing slopes less than 15% is greater than the share of the project site with existing slopes greater than 15%. On any existing, previously developed slopes steeper than 15%, restore the slope area with native plants
	BREEAM Communities	LE 01 – Ecology strategy	To ensure that the development maintains or enhances biodiversity and protects existing natural habitats. Mandatory: An ecological impact assessment (EcIA) has been undertaken by a suitably qualified ecologist
	Greenstar Communities	28. SUSTAINABLE SITES	Environmental approval - 1 point is available where 75% of the project site comprises previously developed land. 1

			point is available where the site contains significant contamination, such that the uses in the proposed development would have been precluded, and the developer has adopted best practice remediation strategies
	Beacon Pathway NSF	Observational Tool: Protection and enhancement of the natural environment	Measured credits for Protection and creation of habitat
3.34 Non-Polluting Lighting Design	LEED-ND	GIB CREDIT: LIGHT POLLUTION REDUCTION	To increase night sky access, improve night time visibility, and reduce the consequences of development for wildlife and people.
	BREEAM Communities	SE 16 – Light pollution	To ensure that lighting on the development site is designed to reduce light pollution. To achieve 2 credits, 100% high efficiency street lighting with limited upward light transmission shall be installed.
	Greenstar Communities	32. LIGHT POLLUTION	1 point is available where, relative to their particular mounting orientation, 95% by number of all external public lighting luminaries within the project site boundary have an Upward Light Output Ratio less than 5%.
	Beacon Pathway NSF	-	N/A

4. Energy Use & Production (Non-transportation)			
Scale: District & Neighbourhood			
Topic	**Certification Scheme**	**Credit**	**Requirements**
4.20 District Heating	LEED-ND	GIB CREDIT: DISTRICT HEATING AND COOLING	Incorporate a district heating and/or cooling system for space conditioning and/or water heating of new buildings to supply at least 80% of the project's annual heating and/or cooling. Single-family residential buildings and existing buildings may be excluded from the calculation.
	BREEAM Communities	RE 01 – Energy strategy	Opportunities to further reduce emissions through the use of decentralised energy including: connection to existing or future heat distribution networks installation of site wide communal heating and cooling networks
	Greenstar Communities	25. GREENHOUSE GAS STRATEGY	1 point is available where the GHG strategy for the project includes one of the following: Connection to an existing or future site wide district heating and cooling network; and/or utilisation of combined heat and power systems.
	Beacon Pathway NSF	-	N/A
4.21 Block Size & Orientation for Microclimate Mitigation	LEED-ND	GIB CREDIT: SOLAR ORIENTATION	Design and orient the project or locate the project on existing blocks such that one axis of 75% or more of the blocks is within ±15 degrees of geographical east-west, and the east-west lengths of those blocks are at least as long as the north-south lengths.
	BREEAM Communities	RE 01 – Energy strategy	Recommendations for reducing energy use and associated emissions beyond baseline levels through implementation of energy efficient measures including: site layout, shading, solar orientation

Topic	Certification Scheme	Credit	Requirements
			use of daylighting, wind management, use of natural ventilation.
	Greenstar Communities	-	N/A
	Beacon Pathway NSF	-	N/A
Scale: Block & Street			
Topic	**Certification Scheme**	**Credit**	**Requirements**
4.30 Dense & Energy Efficient Building Typology	LEED-ND	GIB PREREQUISITE: MINIMUM BUILDING ENERGY PERFORMANCE	Demonstrate an average improvement of 5% for new buildings, 3% for major building renovations, or 2% for core and shell buildings are above ANSI/ASHRAE/IESNA Standard 90.1–2010
	BREEAM Communities	RE 04 – Sustainable buildings	Commit to designing the buildings on site to comply with recognised industry best practice standards in sustainable design for one or more of the fol-lowing key issues: energy, water, waste, embodied impacts of materials, and occupant health and wellbeing.
	Greenstar Communities	11. SUSTAINABLE BUILDINGS	To encourage and recognise projects that deliver sustainable buildings and energy efficient homes, designed and constructed to meet the changing needs of occupants across their lifetime. Points available for non-residential buildings which are eligible to be certified using the Green Star suite of building rating tools or another compliant environmental rating tool, that achieve a certified rating. Residential buildings: percentage of all dwellings in the project site, which are eligible to be certified using the Homestar rating tool, that achieve a rating of 6 Stars or greater
	Beacon Pathway NSF	Item E - Observational Tool / Question 6 - Resident Survey Tool	Observational tool: Dwelling sustainability (condition, resource efficiency, healthy housing). Resident survey: How much do you agree or disagree with the following statements: My home is generally warm and comfortable; My home is energy efficient
4.31 Micro-Climate Mitigation: Low albedo surface materials; Urban Forest & vegetation; High street height vs. width ratio	LEED-ND	GIB CREDIT: HEAT ISLAND REDUCTION	Option 1. Nonroof: Use any combination of the following strategies for 50% of the nonroof site paving. Option 2. High-Reflectance and Vegetated Roofs.
	BREEAM Communities	SE 08 – Microclimate	To ensure the development provides a comfortable outdoor environment through the control of general climatic conditions. A microclimatic simulation/study shall show the effect of urban morphology on the external micro-climate of the development and surrounding area.
	Greenstar Communities	31. HEAT ISLAND EFFECT	1 point is available if at least 50% of the total project site area, in plan view, comprises building or landscaping elements that reduce the impact of heat island effect, i.e. green roofs, vegetation or roof materials with high reflectivity
	Beacon Pathway NSF	-	N/A
*4.41 Increased Local Energy	LEED-ND	GIB CREDIT: RENEWABLE ENERGY	Incorporate on-site nonpolluting renewable energy generation, such as solar, wind, geothermal, small-scale or micro-hydroelectric, or biomass, with production

Topic	Certification Scheme	Credit	Requirements
Production (Solar & Wind)		PRODUCTION	capacity of at least 5% of the project's annual electrical and thermal energy cost (exclusive of existing buildings).
	BREEAM Communities	RE 01 – Energy strategy	Where included as part of the development, the installation of low or zero carbon technologies can be used to offset emissions arising from regulated and unregulated energy consumption.
	Greenstar Communities	23. PEAK ELECTRICITY DEMAND REDUCTION	Points are available where at least 30% of the annual electrical energy needs of the project are met through on-site power generation systems.
	Beacon Pathway NSF	-	N/A

5. Equity & Health

Scale: District & Neighbourhood

Topic	Certification Scheme	Credit	Requirements
5.22 Limited Location of Point Source Pollution & Toxins	LEED-ND	GIB PREREQUISITE: CONSTRUCTION ACTIVITY POLLUTION PREVENTION	To reduce pollution from construction activities by controlling soil erosion, waterway sedimentation, and airborne dust.
	BREEAM Communities	LE 03 – Water pollution	To ensure that measures are put in place to protect the local watercourse from pollution and other environmental damage.
	Greenstar Communities	24. INTEGRATED WATER CYCLE	The quantity of key pollutants discharged in site stormwater is limited, based on the percentage reduction of sediment, phosphorus, nitrogen, and litter in project runoff when compared to untreated runoff.
	Beacon Pathway NSF	-	N/A
5.23 Community Engagement	LEED-ND	NPD CREDIT: COMMUNITY OUTREACH AND INVOLVEMENT	To encourage responsiveness to community needs by involving the people who live or work in the community in project design and planning and in decisions about how the project should be improved or changed over time.
	BREEAM Communities	GO 02 – Consultation and engagement	To ensure the needs, ideas and knowledge of the community are used to improve the quality and acceptability of the development throughout the design process.
	Greenstar Communities	10. Community Development	To encourage and recognise projects that engage in and facilitate the development of the project's community. Minimum requirement: a Community Development Plan for the project community must be developed and implemented.
	Beacon Pathway NSF	Question 11 & 13 - Resident Survey Tool	How many other households do you know in your neighbourhood? How much do you agree or disagree with the following statements: My neighbourhood has a strong sense of community; There are activities run by community that my family or I participate in (eg markets, fairs, fun runs, arts events, children's activities)

Scale: Block & Street

Topic	Certification Scheme	Credit	Requirements
5.30 Active & Attractive Open Space	LEED-ND	NPD CREDIT: ACCESS TO CIVIC AND PUBLIC SPACE	Locate 90% of planned and existing dwelling units and nonresidential use entrances within 400 m walk of at least one civic and passive use space. The spaces must be at least 0.067 hectare in area. Spaces less than 0.4 hectare must have a proportion no narrower than 1 unit of width to 4 units of length.
	BREEAM Communities	SE 11 – Green infrastructure	To ensure access to high quality space in the natural environment and/or urban green infrastructure for all. The masterplan is designed to allow all residents to be within walking distance of greenspace via a safe and convenient pedestrian route.
	Greenstar Communities	09. Healthy and Active Living	Recreational Facilities: points are available where all habitable buildings have easy access to both a local park and at least one publicly accessible sports facility. To be deemed to have easy access, all habitable buildings must be within the following radius to the local park and indoor or outdoor sports facility: Local Park — 400m Publically Accessible Sports Facility — 800m
	Beacon Pathway NSF	Observational Tool & Question 14 - Resident Survey Tool	Observational tool: assessment of Quality of space: Streetscape (including but not limited to walkability) & Public open space. Resident Survey: How much do you agree with the following statement: The quality of local parks and reserves are excellent
5.31 Site Design for Ownership & Surveillance	LEED-ND	NPD CREDIT: WALKABLE STREETS	If the project has ground-floor dwelling units, the principal level of at least 50% of those units has an elevated finished floor at least 24 inches (60 centimeters) above the sidewalk grade. Below-grade basement spaces and/or accessory dwelling units are exempt.
	BREEAM Communities	TM 02 – Safe and appealing streets	To create safe and appealing spaces that encourage human interaction and a positive sense of place. Street layouts and the design of pedestrian and cycle routes are safe and secure by incor-porating the following: in residential areas, all streets and open spaces will be overlooked by multiple dwellings; a clear distinction is made between public, semi-public and private external spaces.
	Greenstar Communities	15. SAFE PLACES	All tunnels and underpasses within the project site must have end-to-end visibility; and all public areas, such as playgrounds, skate parks and community food gardens, must be visible from at least one street. Additional points: crime risk assessment; design strategy that incorporates designing out crime principles.
	Beacon Pathway NSF	Observational Tool & Question 10 - Resident Survey Tool	Professional judgement and/or direct observation to assess if there is good surveillance of public spaces. Question: Thinking about safety, in general how safe or unsafe do you feel in the following situations: Walking in my neighbourhood during the day; Walking alone in my neighbourhood after dark
5.32 Affordable Housing Strategies	LEED-ND	NPD CREDIT: HOUSING TYPES AND AFFORDABILITY	Credit Option 2: Affordable housing - Include a proportion of new rental and/or for-sale dwelling units priced for households earning less than the area median income. Rentals must be maintained at affordable for

			min. 15 years
	BREEAM Communities	SE 05 – Housing provision	To minimise social inequalities and foster a socially inclusive community by ensuring appropriate housing provision within the development. The developer and local authority agree on specific targets for the number of affordable rented, social rented and intermediate affordable housing.
	Greenstar Communities	17. AFFORDABILITY	Points are awarded where at least two residential affordability strategies are implemented for a proportion of the total residential area delivered as part of the project.
	Beacon Pathway NSF	Question 8 & 13 - Resident Survey Tool	Can you please tell us what your household income was last year before tax? How much do you agree or disagree with the following statement: My neighbourhood welcomes people of all ages, abilities, cultures and socio-economic backgrounds
5.34 Mix of Unit Types	LEED-ND	NPD CREDIT: HOUSING TYPES AND AFFORDABILITY	Credit Option 1: Include a sufficient variety of housing sizes and types in the project such that the total variety of planned and existing achieves a Simpson Diversity Index score greater than 0.5.
	BREEAM Communities	SE 05 – Housing provision	The range of different types of affordable homes required for the development site must reflect the local requirements
	Greenstar Communities	17. AFFORDABILITY	Residential Affordability: Providing a diversity of lot sizes to support housing diversity, and a mix of densities with increased density near activity centres;
	Beacon Pathway NSF	Observational Tool: Diversity	Housing diversity (cost, size and typology), assessed through a mixture of measurement and professional judgement within tight guidelines
5.35 Accessibility	LEED-ND	NPD Credit: Visitability and Universal Design	To increase the proportion of areas usable by a wide spectrum of people, regardless of age or ability. For projects with new dwellings, Design a minimum of 20% of the new dwelling units in accordance with ICC A117.1, Type C, Visitable Unit
	BREEAM Communities	SE 15 – Inclusive design	To create an inclusive community by encouraging the construction of a built environment that optimises accessibility. Strategies shall include issues of accessibility, inclusion and emergency egress for all occupants and visitors, with specific consideration to people's wellbeing and age, gender, ethnicity, beliefs and/or dis-ability related needs.
	Greenstar Communities	09. Healthy and Active Living	One point is awarded where the development has been designed and built in line with holistic active and healthy living principles; Encourage social interaction through safety and accessibility features for all.
	Beacon Pathway NSF	-	N/A
The structure for this comparison was based on the sustainable urban design framework developed by Larco, N. (2015). Sustainable urban design – a (draft) framework. Journal of Urban Design, 21, 1, 1-29.			

6. APPENDIX 2: Proposed Post-Occupancy Evaluation framework for neighbourhoods in New Zealand

Based on the national and international examples and standards presented, a methodology is proposed for the case study of this research: the neighbourhood of Hobsonville Point in Auckland. This evaluation shall include both quantitative and qualitative assessments. The subsequent table in this appendix summarises all aspects to be evaluated.

Quantitative Assessment

The quantitative aspects can be evaluated through site observations and measurements, mapping and GIS technologies. This includes all aspects that Appendix 2 shows the parameters to be evaluated according to each topic and scale.

Qualitative Assessment

The qualitative component can be comprised of an initial questionnaire sent to residents and subsequently the discussion within focus groups. The aim of the questionnaire is to understand resident's perception and actions on the sustainability themes investigated. The proposed questionnaire to be used as a basis for the discussion in focus groups is presented in Appendix 3.

Summary: Proposed POE Framework		
Specific Topic	Quantitative Assessment: Mapping, GIS analysis, on-site observation	Qualitative Assessment: Questionnaire and focus groups
1. Energy Use & Greenhouse Gas (Transportation & Land Use)		
Scale: District & Neighbourhood		
1.20 Robust Pedestrian Networks: Small & Defined Blocks; High Network Connectivity	Measure average block sizes; number of intersections per square kilometre	N/A
1.21 High Density Zoning & Platting	Measure neighbourhood density in dwellings per hectare	N/A
1.22 Macro Parking Management & Design	Measure average number of parking spaces per unit - private and public, check visual predominance of parking spaces and garage doors	N/A
1.23 High Micro Scale Land Use Mix	Measure proportion of residential, commercial, institutional uses	How do you evaluate the proximity from your dwelling to local ammenities? How often do you go to local shops, cafes, etc?
Scale: Block & Street		
1.30 Multimodal Street Design: 1.301 Walkable Streets	Measure width of sidewalks, disruptions by crossings and other obstacles, presence of protection from weather.	How much do you walk in a regular day in your neighbourhood? How do you evaluate the infrastructure for walking in your neighbourhood?
1.30 Multimodal Street Design: 1.302 Robust Bicycle Infrastructure	Observaton of availability of dedicated bicycle paths, bicycle storage facilities. Measure the number of bicycle trips in selected streets.	How often do you cycle in a regular week? How safe do you feel when cycling in your neighbourhood?
1.30 Multimodal Street Design: 1.303 Design for Transit	Availability of public transport options, frequency of public transport services	What are your main modes of travel over the course of a typical week? How satisfied do you feel in relation to the following: Public transport options, public transport frequency
1.30 Multimodal Street Design: 1.304 Limiting Motor Vehicle Impact	Number of parking spaces	How important is vehicle ownership to you? How many vehicles do you own?
1.31 Dense & Street Activating Building Typologies	Measure the number of doors and windows facing streets; proportion of facade taken by garage doors	N/A
2. Water		
Scale: District & Neighbourhood		
2.20 Avoid Flood Prone Areas	Check presence of Overland Flow Paths within the neighbourhood	Do you feel that your neighbourhood is well prepared to prevent flooding issues?
2.2 Robust Stormwater Management Network (Distributed & On-Site Recharge)	Presence of stormwater features, i.e. raingardens, soakage areas	Have you ever experienced any flooding problems in your neighbourhood? i.e. roads not holding to capacity of rainfall, houses getting flooded
Scale: Block & Street		

2.30 High Surface Permeability	Measure average surface permeability through mapping or Council records	N/A
2.33 Rainwater Capture & Re-use, Water use reduction	Is there greywater reuse in your household? Does your household have a rainwater collection tank?	How do you feel about the possibility of greywater reuse in your dwelling? Do you feel your neighbourhood is well prepared in case a regional water shortage happens?
3. Ecology & Habitat		
Scale: District & Neighbourhood		
3.20 Ecological Corridors & Pockets	Check if green spaces/conservation areas are interconnected or isolated	How do you feel about connection to nature in your neighbourhood?
3.21 High Urban Forest Continuity & Diversity	Measure average number of trees per square kilometre	How would you evaluate the landscaping of streets and public spaces in your neighbourhood? Do you have a view to a green space/trees from your house?
Scale: Block & Street		
3.31 Micro-Habitat Creation	Check presence of native flora and fauna within the development	How often do you see native birds in your neighbourhood?
3.34 Non-Polluting Lighting Design	Check if street lighting has an upward Light Output Ratio less than 5%.	N/A
4. Energy Use & Production (Non-transportation)		
Scale: District & Neighbourhood		
4.20 District Heating	Check if district heating strategy is present	How do you feel about the idea of a district heating system to be distributed to households in your neighbourhood?
4.21 Block Size & Orientation for Microclimate Mitigation	Check prevailing orientation of lots and buildings	N/A
Scale: Block & Street		
4.30 Dense & Energy Efficient Building Typology	How much are your monthly energy bills in winter and in summer?	How do you evaluate natural ventilation in your building? How comfortable do you generally feel in your household in regards to temperature in winter?
4.31 Micro-Climate Mitigation: Low albedo surface materials; Urban Forest & vegetation; High street height vs. width ratio	From aerial photos, measure average roof colours and permeable surfaces	N/A
4.33 Platting for Density & Solar Exposure	Measure solar exposure through modelling for different seasons	How do you evaluate the sun exposure in your household?
*4.41 Increased Local Energy Production (Solar & Wind)	Check the presence of solar and wind power generation	Do you feel your neighbourhood is prepared in the case of a power cut?
5. Equity & Health		
Scale: District & Neighbourhood		
5.22 Limited Location of Point	Measure CO$_2$ concentration, NO$_2$	How do you evaluate air quality in

Source Pollution & Toxins	and other air contaminants	your neighbourhood?
5.23 Community Engagement	Presence of community centres, community groups and events	How many neighbours do you personally know?
Scale: Block & Street		
5.30 Active & Attractive Open Space	Measure distance from dwellings to nearest open space, Measure square meters of public outdoor recreation space per capita	How do you evaluate the public open spaces in your neighbourhood? How often do you go to parks and playgrounds?
5.31 Site Design for Ownership & Surveillance	Check passive surveillance of streets and open spaces through building features; check if clear separation of public and private spaces	N/A
5.32 Affordable Housing Strategies	Research average housing prices in the neighbourhood	How do you evaluate affordability in your neighbourhood?
5.35 Accessibility	Evaluate presence of universal design features within the development, i.e. textured tiles for blind, continuous access for wheelchairs and trolleys, etc	How satisfied do you feel in relation to the following: Sidewalks, Pedestrian Crossings

7. APPENDIX 3: a proposed questionnaire for a Post-Occupancy Evaluation framework

As part of the POE framework, this questionnaire can be used as base start for the discussion with residents in focus groups, as it contains more complex questions about sustainability and liveability.

Sections:

A. Background & demographics questions

B. Energy Use & Greenhouse Gas (Transportation & Land Use)

C. Water

D. Ecology & Habitat

E. Energy Use & Production (Non-Transportation)

F. Equity & Health

1. **How long have you been living in this neighbourhood?**

    a) Less than 1 year

    b) 1 – 3 years

    c) 3 – 5 years

    d) More than 5 years

2. **Do you rent or own your dwelling?**

    a) Rent

    b) Own

    c) Share with others / Flatmate

    d) Social/Public Housing

3. **How many people live in your household?**

    a) 1

    b) 2

    c) 3

    d) 4

    e) 5

    f) 6 or more

4. **Of the following, which best describes the building you live in?**

    a) Single-family detached house

    b) Duplex (attached house)

    c) Terrace housing / Row houses

    d) Apartment complex

5. **Of the following, which best describes your unit?**

    a) Studio

    b) 1 Bedroom

    c) 2 Bedroom

d) 3 Bedroom

e) 4 Bedroom or more

6. **Of the following, what best describes your ethnicity?**

   a) New Zealand

   b) European

   c) Maori

   d) Pacific

   e) Asian

   f) Middle Eastern / Latin American / African

   g) Other

7. **Of the following, what best describes your total household annual gross income?**

   a) Less than $40,000

   b) $40,000-$80,000

   c) $80,000-$120,000

   d) $120,000-$160,000

   e) More than $160,000

8. **How many people in your household are in the following age groups? (Write the number for each)**

   4 and under: _____

   5-9: _____

   10-19: _____

   20-29: _____

   30-39: _____

   40-49: _____

   50-59: _____

   60-69: _____

   70+: _____

B. Energy Use & Greenhouse Gas (Transportation & Land Use)

9. **How many vehicles do your own in your household?**
   a) 1
   b) 2
   c) 3
   d) 4 or more

10. **How many parking spaces are there in your household? (including garages, carports, parking spaces off street**
    a) 1
    b) 2
    c) 3
    d) 4 or more

11. **How important is vehicle ownership to you?**
    a) Not important
    b) Somewhat important
    c) Very important

12. **How far is your workplace / study place from home?**
    a) 0-5 Km
    b) 5-10 Km
    c) 10-20 Km
    d) More than 20 Km

13. **What is the average monthly distance covered by all household motor vehicles?**
    a) Less than 500 kilometres each month
    b) 500 – 1,000 kilometres each month
    c) 1,000 - 3,000 kilometres each month
    d) More than 3,000 kilometres each month

14. How long do you spend commuting every day?

a) Up to 15 minutes

b) 15-45 minutes

c) More than 45 minutes

15. What are your main modes of travel over the course of a typical week? (Please rank from most frequent to least frequent (1=most frequent, 7=least frequent)

a) Bus or train

b) Ferry

c) Car – with one or more passengers

d) Car – alone

e) Bicycle

f) Walking

g) Other: _____

16. How long do you walk and cycle in a typical weekday?

a) Walk: _____ minutes

b) Cycle: _____ minutes

17. How satisfied do you feel in relation to the following?

	Very Dissatisfied	Dissatisfied	Neutral	Satisfied	Very Satisfied
Parking availability					
Roads					
Cycle ways					
Sidewalks					
Pedestrian crossings					
Public transport options					
Public transport frequency					

18. How often do you use the following local amenities in your neighbourhood?

- Local shops – Daily/Weekly/Monthly/Less often

- Café – Daily/Weekly/Monthly/Less often

- Park – Daily/Weekly/Monthly/Less often

- Playground – Daily Weekly/Monthly/Less often

- Farmers Market – Daily/Weekly/Monthly/Less often

- Participation in local groups – Daily/Weekly/Monthly/Less often

C. Water

19. Does your household have a rainwater collection tank?

    a) Yes

    b) No

    c) Don't know

20. Do you use rainwater in your household? (i.e. for toilets, garden, laundry)

    a) Yes

    b) No

    c) Don't know

21. Is there greywater reuse in your household? (i.e. water from shower is reused in toilets)

    a) Yes

    b) No

    c) Don't know

22. How do you feel about the possibility of greywater reuse in your dwelling?

    a) Enthusiastic

    b) Neutral

    c) Concerned

23. Do you feel that your neighbourhood is well prepared to prevent flooding issues?

    a) Yes

    b) No

24. Have you ever experienced any flooding problems in your neighbourhood? i.e. roads not holding to capacity of rainfall, houses getting flooded

    a) Yes

    b) No

25. Do you feel your neighbourhood is well prepared in case a regional water shortage happens?

    A) Yes

    B) No

    C) Don't know

26. How do you evaluate the quality of tap water in your household?

    A) Very good – I drink tap water without any issues

    B) Medium

    C) Bad – I don't drink water from the tap

D. Ecology & Habitat

27. Do you have a view to a green space/trees from your house? (Not including landscape in your own lot)

a) Yes, a good view to nature

b) Partial view

c) No view

28. How do you feel about connection to nature in your neighbourhood?

a) There are enough trees/ natural features

b) Neutral

c) There should be more natural features

29. How do you evaluate the noise level in your household? (from external noise)

a) Loud

b) Moderate

c) Quiet

30. How do you evaluate the noise level in your street?

a) Loud

b) Moderate

c) Quiet

31. How do you evaluate the air quality level in your neighbourhood?

a) Good/fresh

b) Neutral

c) Bad/Polluted

32. Do you separate recycling from rubbish for waste collection?

a) Yes

b) No

33. Do you compost your household's food waste?

a) Yes

b) No

34. From your usual groceries, how much do you buy locally in your neighbourhood?

a) 0-25%

b) 25-50%

c) 50-75%

d) 75-100%

35. Do you produce food in your household?

a) Yes, plenty of fruits, vegetables, herbs

b) Yes, but only a few

c) No

36. How many trees do you have in your house?

a) 1-2

b) 2-3

c) 4 or more

37. How often do you see native birds in your neighbourhood?

a) Often

b) Rarely

c) Don't know

38. How would you evaluate the landscaping of streets and public spaces in your neighbourhood?

a) Adequate landscaping, good quantity of trees and vegetation in streets

b) Moderate

c) Bad landscaping, not enough trees/vegetation

39. Does your household have any of the following energy features?

  a) Solar panels for water heating

  b) Solar panels for electricity generation

  c) Other:

40. How do you evaluate the sun exposure in your household?

  a) Not enough sun / too shaded from neighbouring buildings

  b) Average

  c) Good amount of sun

41. How much are your monthly energy bills in winter?

  a) Less than $100

  b) $100-$200

  c) $200-$300

  d) More than $300

42. How much are your monthly energy bills in summer?

  a) Less than $100

  b) $100-$200

  c) $200-$300

  d) More than $300

43. How do you evaluate natural ventilation in your building?

  a) Good, well ventilated

  b) Neutral

  c) Bad, not well ventilated

44. What is the main heating source in your household?

  a) Heat pumps

  b) Portable electric heater

c) Central Heating

d) Heat recovery ventilation system

e) No active heating – only passive solar heating

f) Other

45. How do you feel about the idea of a district heating system to be distributed to households in your neighbourhood?

A) Enthusiastic

B) Neutral

C) Concerned

46. Have you ever experienced a power cut in your neighbourhood?

A) Yes

B) No

C) Don't know

47. Do you feel your neighbourhood is prepared in the case of a power cut?

A) Yes

B) No

C) Don't know

48. How would you evaluate housing affordability in your neighbourhood?

a) Very affordable

b) Fairly Affordable

c) Neutral

d) Fairly Unaffordable

e) Very unaffordable

49. How do you feel about privacy in your household in relation to neighbours?

a) Very satisfied

b) Fairly Satisfied

c) Neutral

d) Fairly Unsatisfied

e) Very unsatisfied

50. How safe do you feel in the following situations in your neighbourhood?

	Very unsafe	Fairly unsafe	Neutral	Fairly safe	Very safe
Walking during the day					
Walking at night					
Cycling					
In your house during the day					
In your house at night					
Letting children play independently outside					

51. How many neighbours do you personally know?

a) Less than 2

b) 3-4

c) 5-8

d) 10-14

e) 15-19

f) 20+

52. How satisfied are you in regards to the following local amenities:

	Very Dissatisfied	Dissatisfied	Neutral	Satisfied	Very Satisfied
Schools					
Shops					
Cafes & Restaurants					
Green/Public Spaces					
Playgrounds					

53. Do you feel that your neighbourhood is prepared for extreme weather events i.e. flooding, storms?

a) Yes

b) No

c) Don't know

54. Do you intend to move out in the next couple of years?

a) Yes, to another neighbourhood

b) Yes, within the same neighbourhood

c) No

55. If yes, what is the reason for moving out?

a) Dwelling is not suitable

b) Neighbourhood is not satisfactory

c) Long distance between work and home

d) Not enough space in my household

e) Lack of public transport

f) Other:_____

56. Would you recommend this neighbourhood to other people?

a) Yes

b) No

57. What are the best aspects of living in your neighbourhood?

_____

_____

58. What are the worst aspects of living in your neighbourhood?

_____

_____

59. If you could change something in your neighbourhood, what would it be?

_____

_____

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