



## Planning and Land Use Committee Report For the Meeting of May 28, 2015

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**To:** Planning and Land Use Committee                      **Date:** May 14, 2015

**From:** Mike Wilson, Senior Planner – Urban Design, Development Services Division

**Subject:** **Development Permit with Variances Application No. 000409 for 370 and 384 Harbour Road**

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### RECOMMENDATION

Staff recommend that Committee forward this report to Council and that after giving notice and allowing an opportunity for public comment and after the Public Hearing for Rezoning Application No. 00478, if it is approved, Council consider the following motion:

“That Council authorize the issuance of Development Permit Application No. 000409 for 370 and 384 Harbour Road for the subdivision of land and construction of two multi-unit residential buildings in accordance with:

1. Referral to the Advisory Design Panel with particular attention to the following issues:
  - a. The quality of the exterior materials and their arrangement on the proposed buildings with respect to highlighting the marine and industrial design influences referenced in the guidelines;
  - b. The relationship between the residential unit entries and both the mews and greenway with specific attention to design details that promote pedestrian-friendly streetscapes and pedestrian pathway connections.
2. Preparation of a legal agreement to ensure the recommended noise mitigation measures as described in the report from Wakefield Acoustics dated March 31, 2015 are installed and maintained.
3. Plans date stamped March 31, 2015.
4. Development meeting all *Zoning Regulation Bylaw* requirements, except for the following variances:
  - a. permit residential uses on the ground floor of a building;
  - b. permit residential units to face Harbour Road without a building buffer.
5. Final plans in accordance with the plans identified above to the satisfaction of staff.
6. The Development Permit lapsing two years from the date of this resolution.”

### LEGISLATIVE AUTHORITY

In accordance with Section 920(2) of the *Local Government Act*, Council may issue a Development Permit in accordance with the applicable guidelines specified in the *Official Community Plan*. A Development Permit may vary or supplement the *Zoning Regulation Bylaw* but may not vary the use or density of the land from that specified in the bylaw.

Pursuant to Section 920(8) of the *Local Government Act*, where the purpose of the designation is the revitalization of an area in which a commercial use is permitted, a Development Permit may include requirements respecting the character of the development, including landscaping, and the siting, form, exterior design and finish of buildings and other structures.

## **EXECUTIVE SUMMARY**

The purpose of this report is to present Council with information, analysis and recommendations for a Development Permit Application for the property located at 370 and 384 Harbour Road. The proposal is to construct two separate three-storey buildings with a total of 49 residential dwelling units. The proposal has been evaluated for consistency with Design Guidelines for the Dockside Area.

## **BACKGROUND**

### **Description of Proposal**

The proposal is to construct two separate three-storey buildings with a total of 49 residential dwelling units. Exterior materials include:

- vertical metal cladding
- vertical standing seam metal cladding
- horizontal metal cladding that reads as wood siding
- sealed concrete
- fibre cement board.

The proposed variances are to:

- permit ground-floor residential uses
- allow residential units to be constructed without a buffer of another building between them and Harbour Road.

### **Sustainability Features**

As indicated in the applicant's letter dated March 31, 2015 the following sustainability features are associated with this Application:

- connection to the Dockside Green District Energy Utility
- ultra-low flow plumbing fixtures
- connection to Dockside Green waste water treatment plant
- low off-gas building materials
- improved ventilation for suites
- use of locally sourced materials.

### **Active Transportation Impacts**

The Application proposes the following features which support active transportation:

- the provision of 49 bicycles with a minimum value of \$200 each for tenants of the building
- the provision of 49 enclosed bicycle parking stalls.



## Data Table

The following data table compares the proposal with the CD-9 Zone. An asterisk is used to identify where the proposal is less stringent than the existing zone.

Zoning Criteria	Proposal		Zone Standard CD-9
	Building R-4	Building R-5	
Site area (m <sup>2</sup> ) - minimum	1304.00		n/a
Density (Floor Space Ratio) - maximum	0.63:1		n/a
Total floor area – DA-D (m <sup>2</sup> ) - maximum	5030.60 (existing and proposed)		16 570.00
Height (m) - maximum	8.57	8.56	26.51
Storeys - maximum	3	3	3
Site coverage % - maximum	27.57		n/a
Open site space % - minimum	49.03		n/a
Parking - minimum	7		0
Visitor parking (minimum) included in the overall units	1		1
Bicycle parking stalls (minimum)	19	30	49
Location of Residential Use	Ground Floor*	Ground Floor*	2 <sup>nd</sup> Storey or higher
Buffer Building	Partial Buffer*	No Buffer*	Buffer Required

## Relevant History

A Master Development Agreement (MDA) is registered on the title of the subject lands. This requires, at the Development Permit stage, the provision of a pest management plan, an acoustical assessment, and the provision of transportation demand management measures. These items are discussed in the Analysis section of this report.

## Community Consultation

Consistent with the *Community Association Land Use Committee (CALUC) Procedures for Processing Rezoning and Variances Applications*, the Application was referred for a 30-day comment period to the Victoria West CALUC. At the time of writing this report, a letter from the CALUC had not been received.

This Application proposes variances, therefore, in accordance with the City's *Land Use Procedures Bylaw*, it requires notice, sign posting and a meeting of Council to consider the variances.

## ANALYSIS

### Development Permit Area and Design Guidelines

The *Official Community Plan* (OCP) identifies this property within Development Permit Area 13, Core Songhees. The applicable design guidelines are the *Design Guidelines for the Dockside Area*. The guidelines provide site-wide design guidelines as well as guidelines specific to each sub area.

The applicant proposes a three-storey multi-unit residential building that abuts the slope of the existing greenway. Lower-level units are accessed from the mews (east) while units on levels two and three are accessed from the greenway (west). Each unit has direct access to the outside through the provision of a front door.

Key guidelines relate to the provision of pedestrian-friendly streetscapes, individual unit entrances and consideration of Crime Prevention Through Environmental Design (CPTED) principles. Each of the buildings present multiple unit entrances toward the mews and greenway. The applicant proposes a variety of exterior materials including metal panelling and concrete fibre board. The applicant has proposed five types of metal cladding which vary with respect to texture and reveals. The Application of these materials is deployed in a manner that breaks up the long horizontal extent of each building structure through fine detailing and colour. This is particularly relevant on the east elevation of each of the buildings. On the west elevations, the applicant proposes various shades of fiber cement panels which are accented with stained wood boards. Unit entries are highlighted with brightly coloured doors and soffit mounted lighting. The applicant proposes to break up the horizontal extent of this façade through the provision of projecting bays. These bays will be further defined with individual private patios that are accessible on level two.

The guidelines recommend that architecture in this area should recall the industrial and marine influences with regard to colour selection, materials and form. Staff recommend that Council consider referring this Application to the Advisory Design Panel with specific attention to:

- the quality of the exterior materials and their arrangement on the proposed buildings with respect to highlighting the marine and industrial design influences referenced in the guideline
- the relationship between the residential unit entries from both the mews and greenway with specific attention to design details that promote pedestrian-friendly streetscapes and pedestrian pathway connections.

### Siting of Residential Uses and Noise Mitigation Measures

The two variances associated with this Application are both related to siting of residential uses. In accordance with the Master Development Agreement, the applicant has submitted a Noise Mitigation Report prepared by a Professional Engineer in support of this Development Permit Application. This report also provides support for the proposed variances. A copy of the study is attached to the report.

The consultant conducted noise sampling measurements at various times in the fall of 2014. The intent of the report is to determine what, if any, noise mitigation measures should be incorporated into the building design to mitigate noise from adjacent marine industrial uses on Harbour Road.



The following noise mitigation measures are recommended to be included in the proposed development:

- installation of double-glazed, Low E, argon-filled windows having a Sound Transmission Class Rating of approximately STC 30. Such windows when closed will reduce average outdoor noise levels to achieve interior levels of 35 dBA or less
- strategic installation of windows so that they open away from dominant noise sources
- provision of constant ventilation via a dual-speed fan in each home, allowing for continuous fresh air even when windows are closed
- requiring a minimum of R20 thermal insulation in building walls
- Requiring a majority of bedrooms to be located on west sides of buildings.

Staff have reviewed the report and recommend for Council's consideration that Council accept the proposed mitigation measures and direct staff to secure their installation and maintenance through a legal agreement.

### **Pest Management Plan**

In accordance with the Master Development Agreement, the applicant has submitted a Pest Management Plan in support of this Development Permit Application. A copy of the plan is attached to this report.

### **Transportation Demand Management Measures**

In accordance with the Master Development Agreement, the applicant will be providing the following Transportation Demand Management measures:

- forty-nine bicycles with a minimum value of \$200 each for tenants of the buildings
- forty-nine enclosed bicycle parking stalls
- a car-share membership to a maximum value of \$500 per membership
- a bus pass subsidy of \$15 per month to the British Columbia Transit Authority for three years beginning at occupancy of the buildings.

### **CONCLUSIONS**

The proposal is to construct two separate three-storey buildings with a total of 49 residential dwelling units. The proposal has been evaluated for consistency with Design Guidelines for the Dockside Area. The guidelines recommend that architecture in this area should recall the industrial and marine influences with regard to colour selection, materials and form. Staff recommend for Council's consideration that Council consider referring this Application to the Advisory Design Panel.

A noise mitigation report has been completed which recommends several building elements that will help mitigate potential noise concerns and will help alleviate the possible effects of allowing the construction of the residential units at-grade and without the benefit of a building buffering them from neighbouring commercial and industrial uses. The recommendation provided for Council's consideration contains language to ensure that these features are secured by a legal agreement.

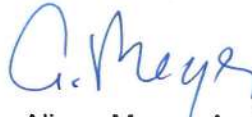
## ALTERNATE MOTION

That Council decline Development Permit with Variances Application No. 000409 for the property located at 370 and 384 Harbour Road.

Respectfully submitted,



Mike Wilson  
Senior Planner – Urban Design  
Development Services Division



Alison Meyer, Assistant Director  
Sustainable Planning and  
Community Development



Andrea Hudson, Acting Director  
Sustainable Planning and  
Community Development

Report accepted and recommended by the City Manager:



Jason Johnson

Date:

May 21, 2015

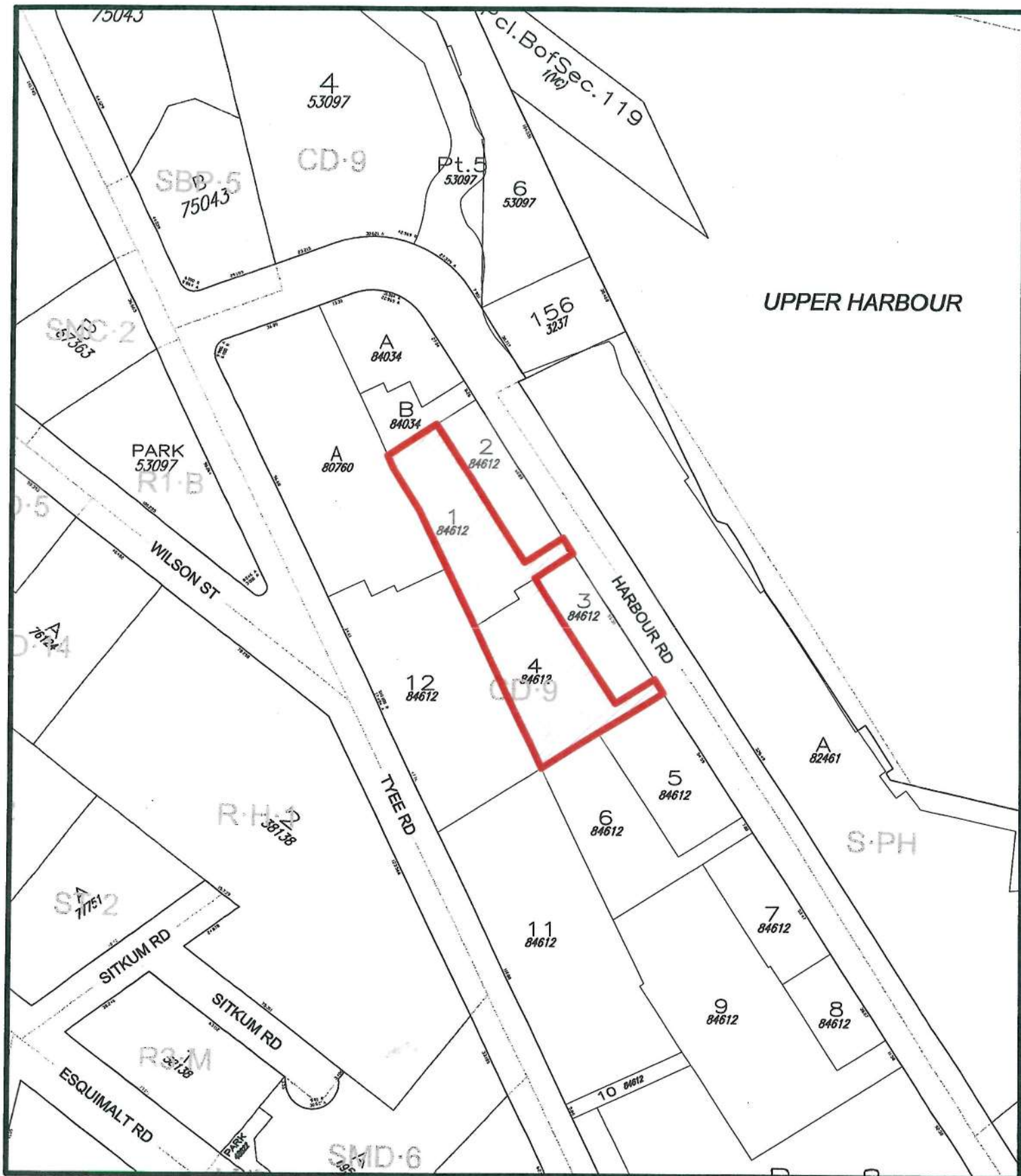
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S:\TEMPEST\_ATTACHMENTS\PROSPERO\PL\REZ\REZ00478\DP DVP PLUC REPORT REVISED.DOC

### List of Attachments

- Aerial Map
- Zoning Map
- Plans date stamped March 31, 2015
- Report from Wakefield Acoustics dated March 31, 2015.

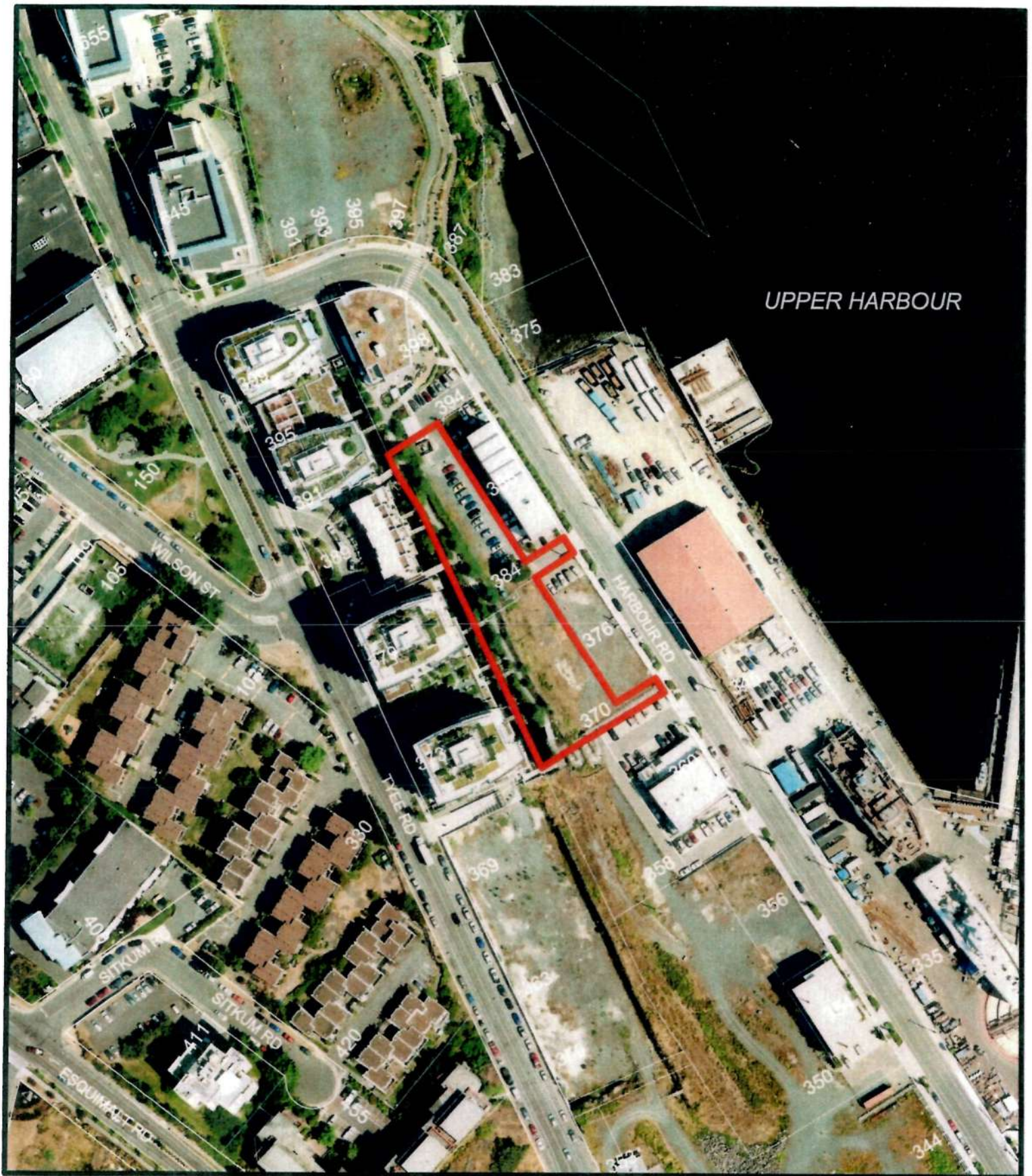




370 and 384 Harbour Road  
Rezoning #00478  
Bylaw #







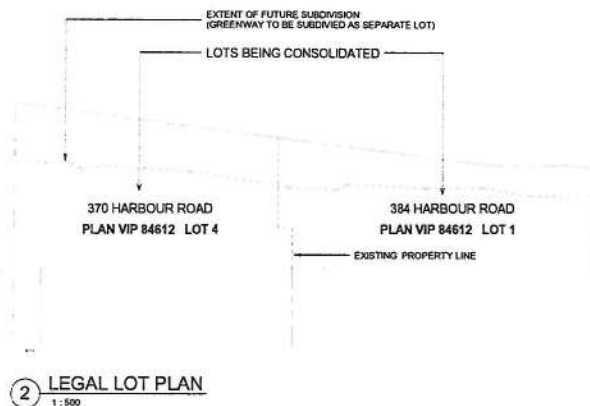
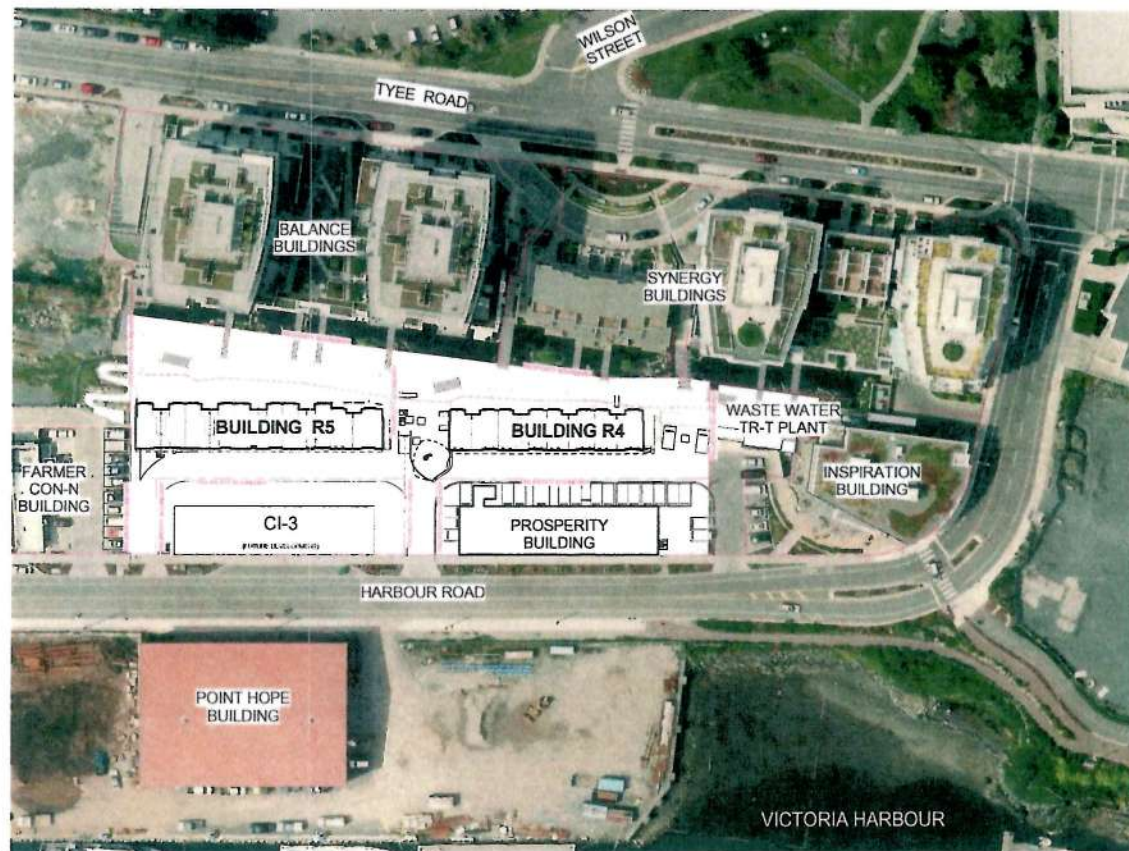
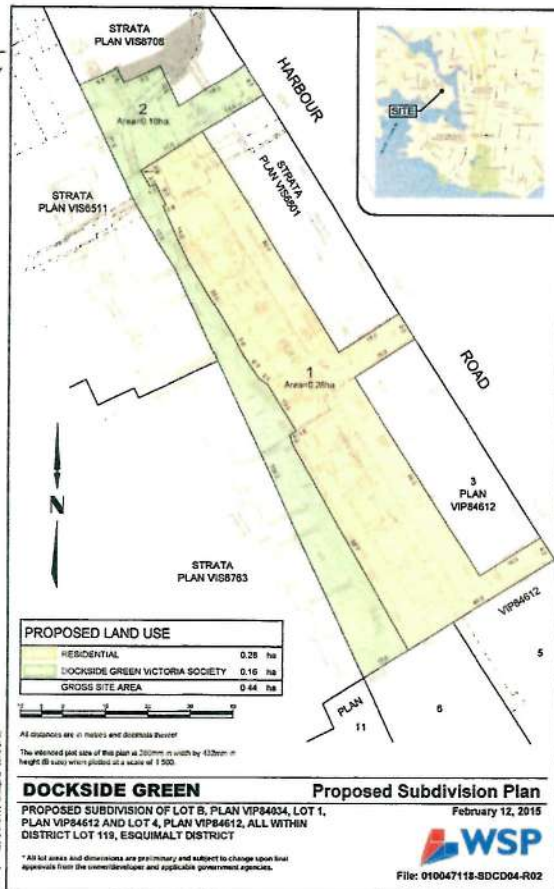
UPPER HARBOUR



370 and 384 Harbour Road  
Development Permit #000409







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**HCMAA**



**DOCKSIDE GREEN - AFFORDABLE HOUSING**  
 370 & 384 HARBOUR ROAD, VICTORIA  
 778-744-4444  
 11/1/2015



**CONTEXT PLAN**  
 DATE: FEB 12, 2015  
**A0.01**  
 SCALE: 1:500

HCMAA Architecture • Design  
 370 & 384 Harbour Road, Victoria  
 778-744-4444  
 11/1/2015

**BUBBLED**





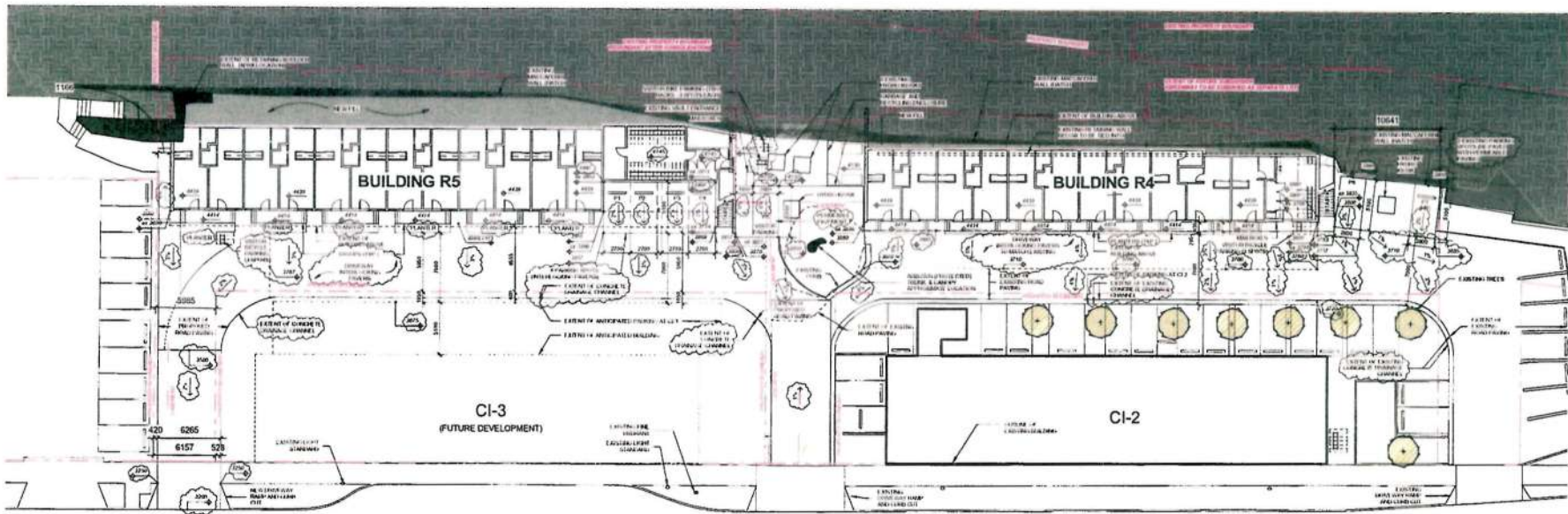


BUILDING R4	BUILDING R5
1020.45	1401.31
8.57	8.56
3	3
3	4
19	20
6	6

PROJECT INFORMATION TABLE (CONTINUED)			
	REQUIRED	PROPOSED	
<b>BUILDING DETAILS</b>			
FRONT YARD PARADELAIN ROAD (m)	0	23.23	
REAR YARD (m)	0	7.12	
LEFT YARD (MOTING) (m)	0	10.74	
SIDE YARD (SOUTH) (m)	0	1.17	
<b>RESIDENTIAL USE DETAILS</b>			
TOTAL NUMBER OF UNITS	NOT APPLICABLE	49	• STUDIO • 1 BEDROOM • DEN • 2 BEDROOM • DEN
UNIT TYPE	NOT APPLICABLE		
GROUND ORIENTED UNITS	NOT APPLICABLE	49	
INTERNAL UNIT FLOOR AREA (sq.m)	NOT APPLICABLE	23.54	
TOTAL RESIDENTIAL FLOOR AREA (sq.m)	NOT APPLICABLE	2230.4	
LIMITS: TYPICAL OUTLINE OF APPROXIMATE HOUSING DEVELOPMENT FOR ZONING C-1.0. ALLOCATIONS AT THE DISCRETION OF THE CITY ENGINEER.			

BUILDING M4	BUILDING R8
23.23	23.45
7.72	13.23
10.74	N/A
N/A	1.17
19	30
- STUDIO 1.0D + DEN 3.0D + DEN	- STUDIO 1.0D + DEN 2.0D + DEN 3.0D + DEN
23.54	27.42
56.73	1264.72

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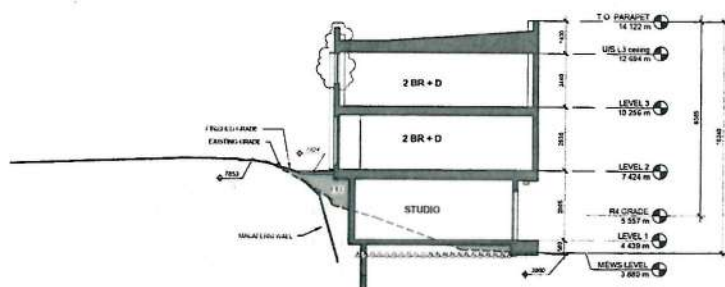
① SITE MEWS  
1:200



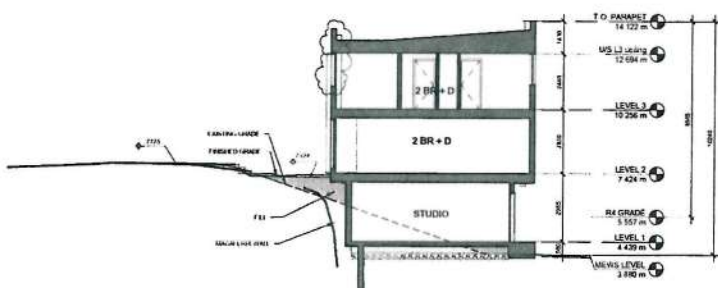
DOCKSIDE GREEN - PROPOSED MASTERPLAN -  
PUBLIC REALM



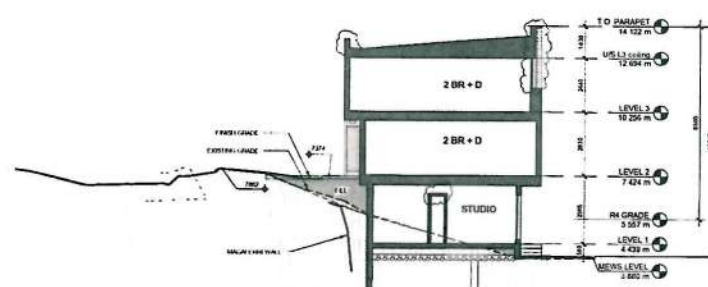
Architectural site plan of the University of California, Berkeley campus, showing the layout of various buildings and their relationships. The plan includes labels for 'PROPOSED BUILDING 15', 'PROPOSED BUILDING 14', 'PROSPERITY BUILDING', 'SYNERGY BUILDINGS', 'WASTE WATER TREATMENT BUILDING', and 'INSPIRATION BUILDING'. It also shows 'BALANCE BUILDINGS' and 'PROPOSED BUILDING 13'. The plan is oriented with North at the top.



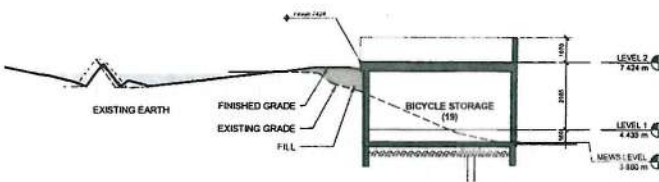
① SECTION - BUILDING R4 at GL 4.1  
1:100



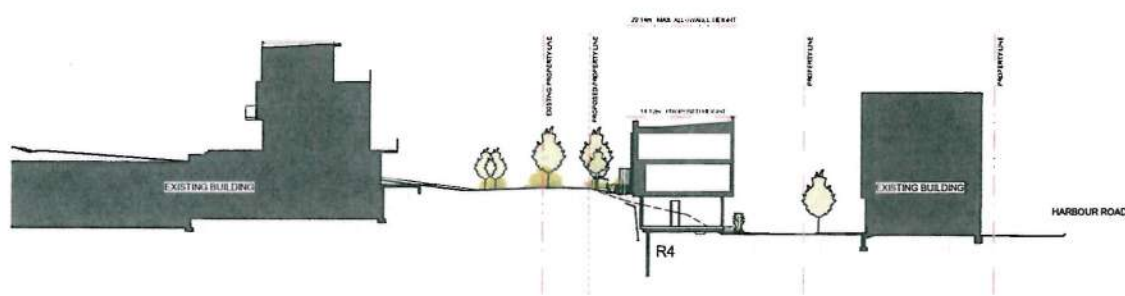
② SECTION - BUILDING R4 at GL 4.3  
1:100



③ SECTION - BUILDING R4 at GL 4.8  
1:100

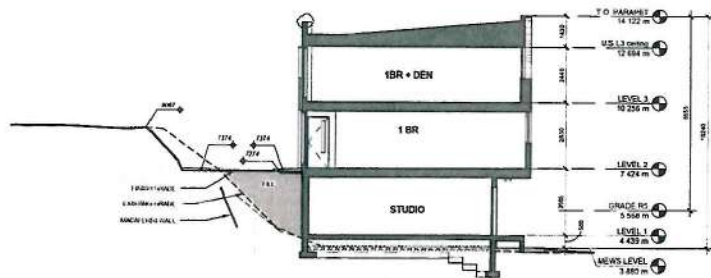


④ SECTION - BUILDING R4 at GL 4.9  
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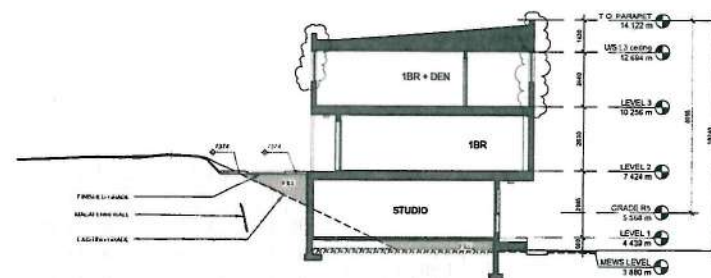


⑤ SITE SECTION - BUILDING R4  
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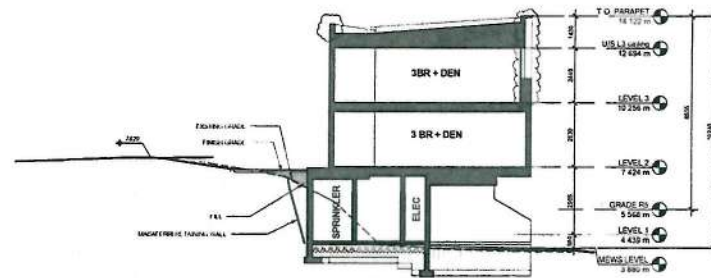




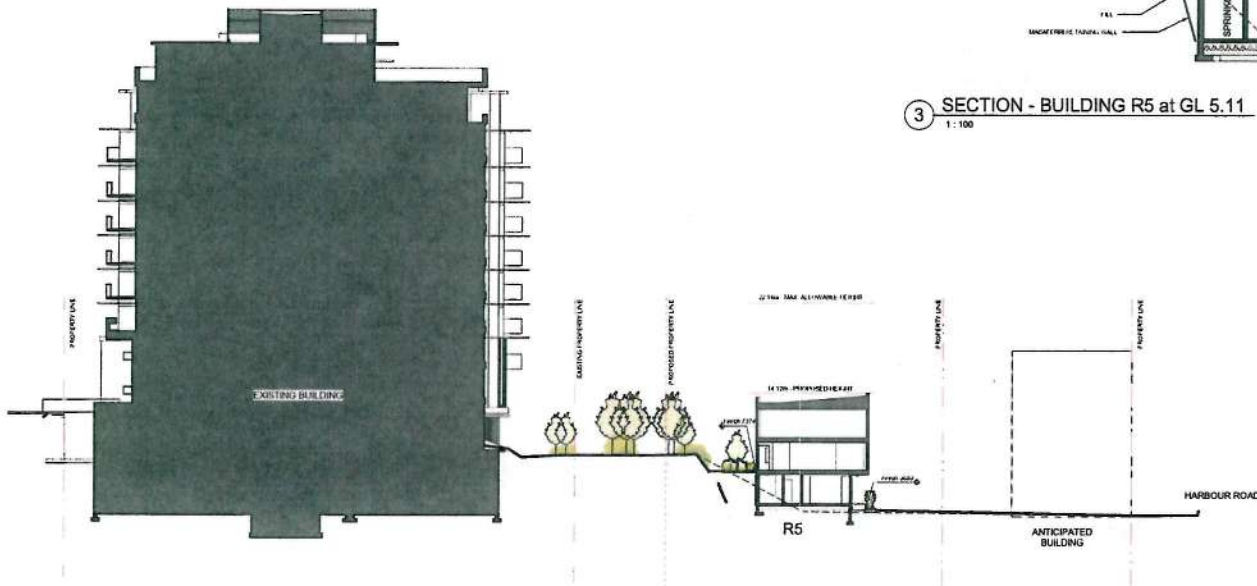
① SECTION - BUILDING R5 at GL 5.1  
1:100



② SECTION - BUILDING R5 at GL 5.8  
1:100



③ SECTION - BUILDING R5 at GL 5.11  
1:100



④ SITE SECTION - BUILDING R5  
1:200

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HGMA



DOCKSIDE GREEN -  
AFFORDABLE HOUSING  
SITE & 3D HARBOUR ROAD, SINGAPORE  
DATE: 14/05/2015  
SCALE: As indicated

SITE SECTIONS - R5

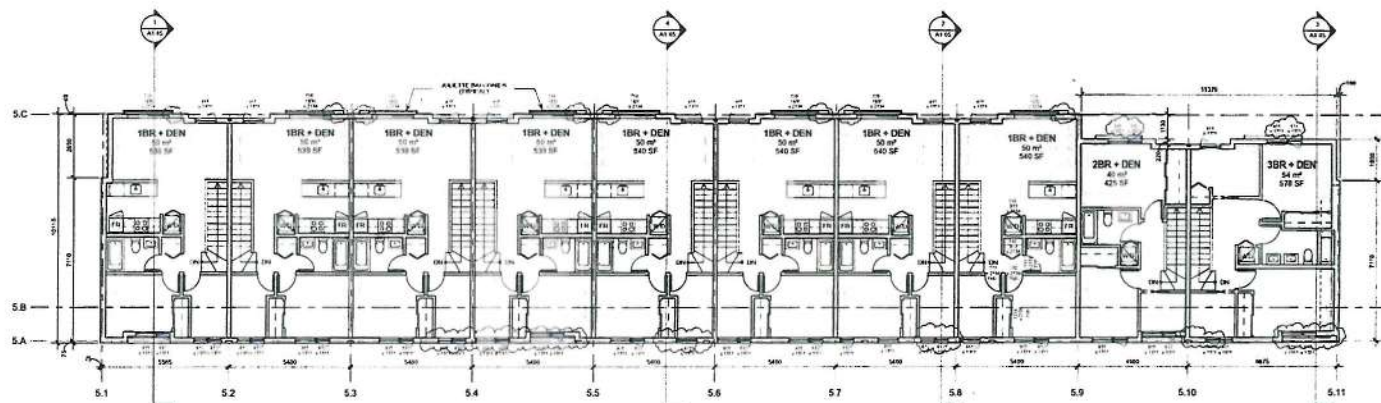
DATE: 14/05/2015  
SCALE: A1.05  
SCALE: As indicated

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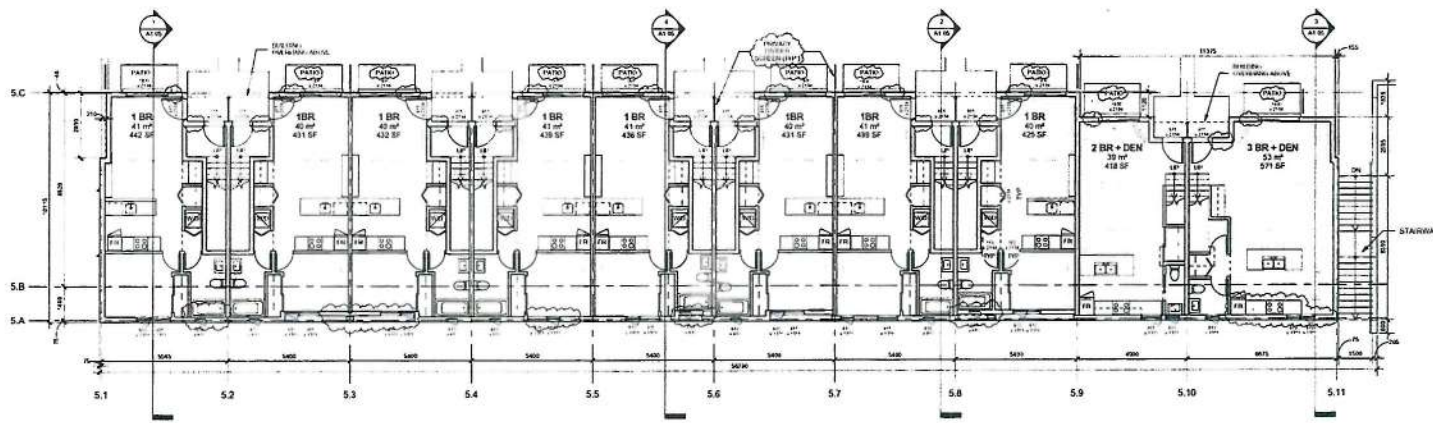




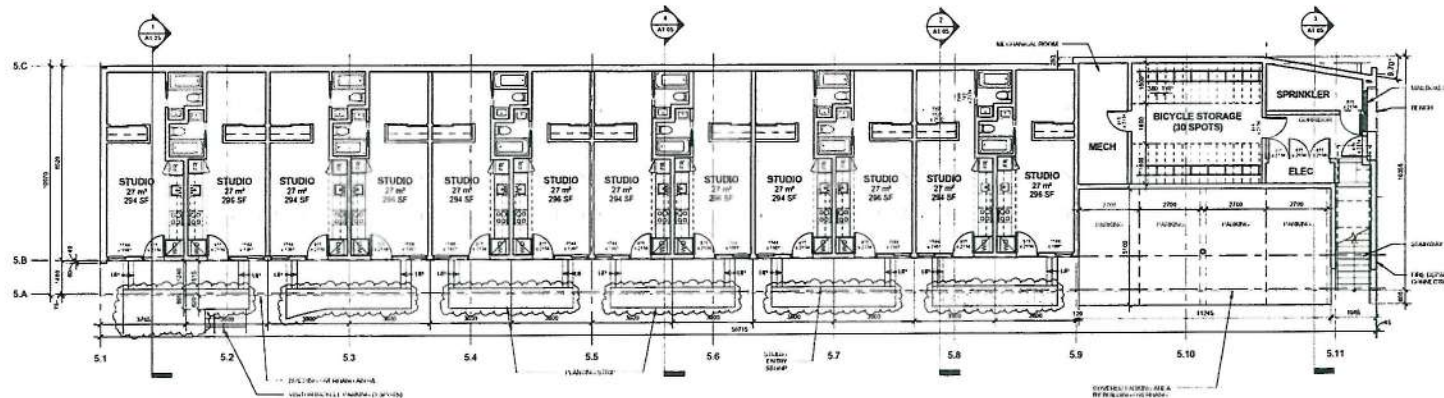
3 LEVEL 3 - BUILDING R5  
1:100



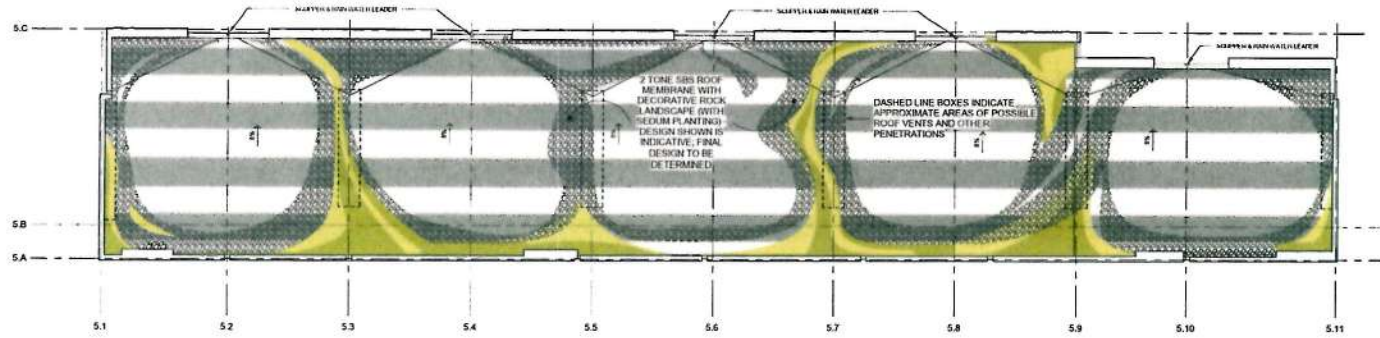
2 LEVEL 2 - BUILDING R5  
1:100



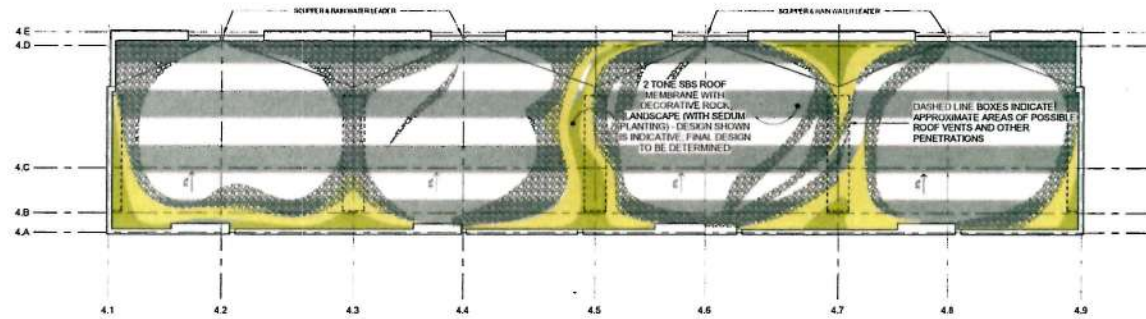
1 LEVEL 1 - BUILDING R5  
1:100



1 ROOF - BUILDING R5  
1:100



2 ROOF - BUILDING R4  
1:100







AVERAGE GRADE FOR BUILDING R4 = 5557

SCREENING:  
- METAL CLADDING 5: SAME AS METAL CLADDING 1; PERFORATED

# HCMV



DOCKSIDE GREEN - AFFORDABLE HOUSING

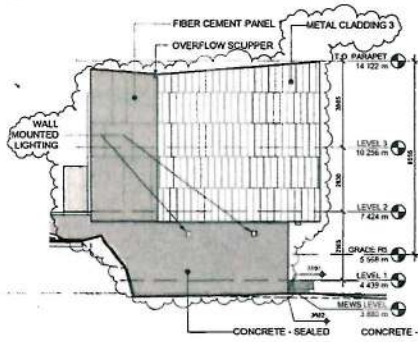
NO.	DATE	DESCRIPTION
1	20/12/23	ACCOMMODATION
2	20/12/23	ACCOMMODATION



#### R4 ELEVATIONS

DATE FEB 13 2015  
**A3.00**

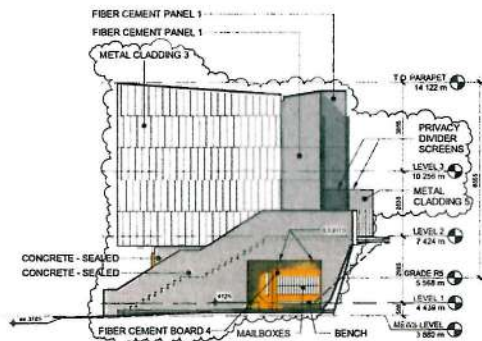
866MA Architecture • Daily  
 Water 400 GPD Water Heating 1  
 www.866ma.com 800 866 8666  
 T 878 732 1400  
 WY Home Co



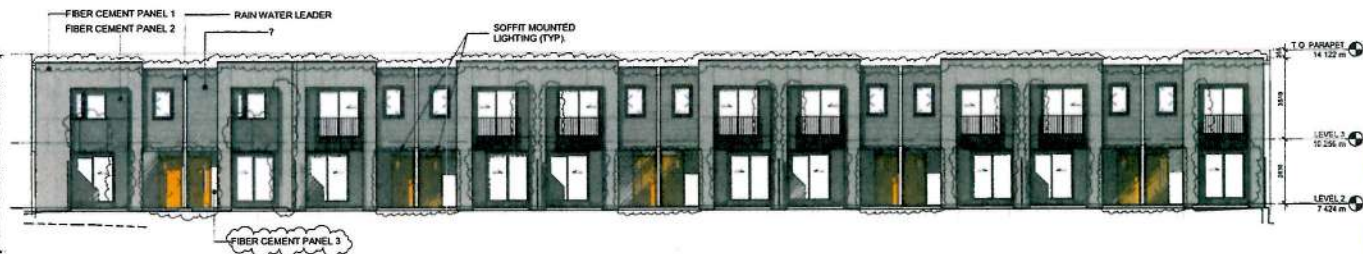
4 R5 SOUTH ELEVATION  
1:100



1 R5 EAST ELEVATION  
1:100



3 R5 NORTH ELEVATION  
1:100



2 R5 WEST ELEVATION  
1:100



#### DOCKSIDE AFFORDABLE HOUSING AVERAGE GRADE CALCULATION

##### BUILDING R5

POINTS A+B	(3880+3880) / 2 x 56792	=22032960
POINTS B+C	(3880+7274) / 2 x 9141	=5097057
POINTS C+D	(7274+7274) / 2 x 11335	=82450790
POINTS D+E	(7274+7274) / 2 x 1129	=8212348
POINTS E+F	(7274+7274) / 2 x 43755	=318273870
POINTS F+A	(7274+3880) / 2 x 10220	=5090940
		737266263

PERIMETER OF BUILDING R5 = 132422

AVERAGE GRADE FOR BUILDING R5 = 5567.5

#### MATERIALS

##### WALLS:

##### METAL CLADDING:

- METAL CLADDING 1: VERTICAL METAL CLADDING PROFILE / EXPOSED FASTENER - WHITE COLOUR
- METAL CLADDING 2: VERTICAL FLUSH METAL PROFILE - RANDOM PATTERN - WHITE COLOUR
- METAL CLADDING 3: VERTICAL STANDING SEAM METAL CLADDING - WHITE COLOUR
- METAL CLADDING 4: HORIZONTAL METAL BOARD CLADDING - WOOD EFFECT

##### SEALED CONCRETE:

- SEALED CONCRETE AS FINISH AND STRUCTURE

##### BOARD SIDING:

- LAPPED WOOD BOARDS WITH SEMI-TRANSPARENT STAIN - MEDIUM GREY

##### FIBRE CEMENT BOARD:

- FIBRE CEMENT BOARD 1 (SMOOTH MATTE) - LIGHT GREY
- FIBRE CEMENT BOARD 2 (SMOOTH MATTE) - DARK GREY
- FIBRE CEMENT BOARD 3 (SMOOTH MATTE) - WHITE
- FIBRE CEMENT BOARD 4 (SMOOTH MATTE) - ACCENT COLOUR

##### SOFFIT:

- METAL CLADDING 1: HORIZONTAL METAL BOARD CLADDING - WOOD EFFECT
- FIBRE CEMENT BOARD 1: IN WHITE AND ACCENT COLOURS AS ABOVE

##### ROOF:

- SBS ROOFING WITH TWO COLOURS LAYED IN STRIPED PATTERN WITH ROCKSCAPING & PLANTING

##### SCREENING:

- METAL CLADDING 5: SAME AS METAL CLADDING 1: PERFORATED

**HCM**



DOCKSIDE GREEN -  
AFFORDABLE HOUSING  
378 & 388 HARBOR ROAD, VICTORIA  
BRITISH COLUMBIA  
V8V 2P2  
PH: 250.683.1111



RS ELEVATIONS

DATE: FEB 16, 2016  
**A3.01**  
SCALE: As Indicated



▽ VIEW OF DOCKSIDE AFFORDABLE HOUSING (BUILDING R5) FROM THE MEWS LEVEL (ARTIST'S CONCEPTION)



# MATERIALS

## WALLS:

### METAL CLADDING:

- METAL CLADDING 1: VERTICAL METAL CLADDING PROFILE / EXPOSED FASTENER - WHITE COLOUR
- METAL CLADDING 2: VERTICAL FLUSH METAL PROFILE - RANDOM PATTERN - WHITE COLOUR
- METAL CLADDING 3: VERTICAL STANDING SEAM METAL CLADDING - WHITE COLOUR
- METAL CLADDING 4: HORIZONTAL METAL BOARD CLADDING - WOOD EFFECT

### SEALED CONCRETE:

- SEALED CONCRETE AS FINISH AND STRUCTURE

### BOARD SIDING:

- LAPPED WOOD BOARDS WITH SEMI-TRANSPARENT STAIN - MEDIUM GREY

### FIBER CEMENT BOARD:

- FIBER CEMENT BOARD 1 (SMOOTH MATTE) - LIGHT GREY
- FIBER CEMENT BOARD 2 (SMOOTH MATTE) - DARK GREY
- FIBER CEMENT BOARD 3 (SMOOTH MATTE) - WHITE
- FIBER CEMENT BOARD 4 (SMOOTH MATTE) - ACCENT COLOUR

### SOFFIT:

- METAL CLADDING 4: HORIZONTAL METAL BOARD CLADDING - WOOD EFFECT

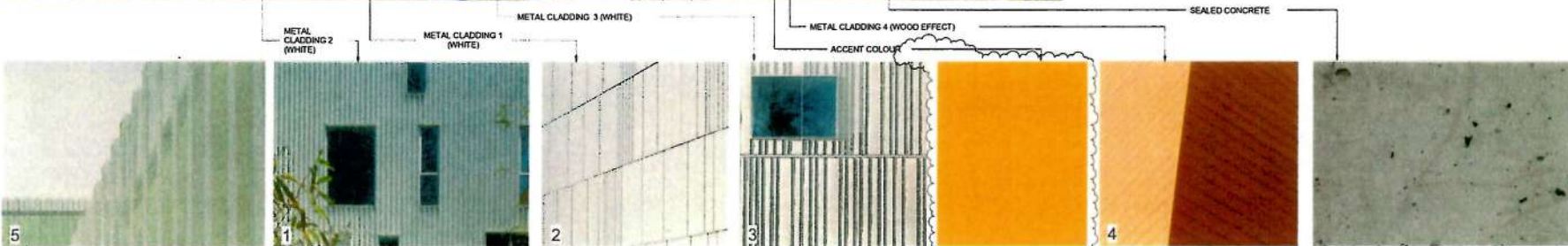
- FIBER CEMENT BOARD: IN WHITE AND ACCENT COLOURS AS ABOVE

### ROOF:

- SBS ROOFING WITH TWO COLOURS LAYED IN STRIPED PATTERN WITH ROCKSCAPING & PLANTING

### SCREENING:

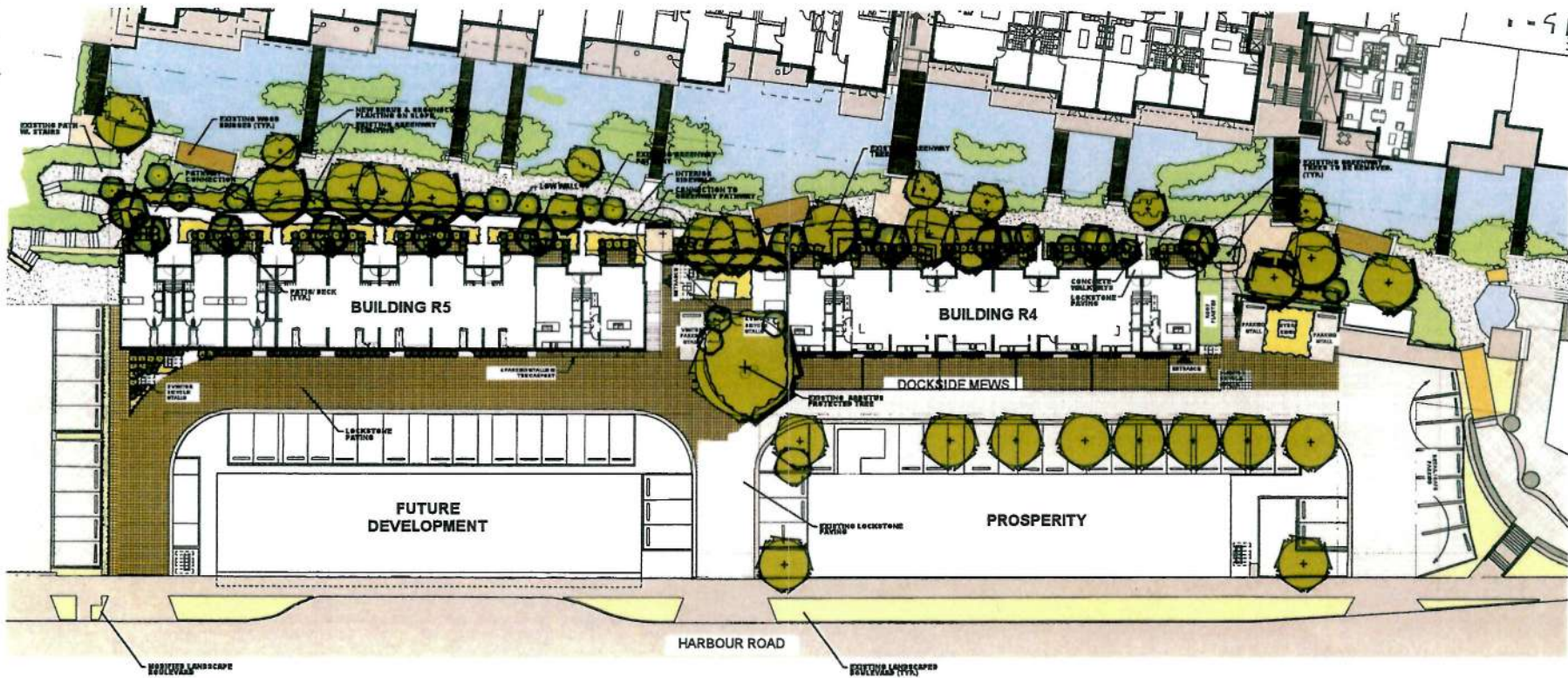
- METAL CLADDING 5: (SAME AS METAL CLADDING 1; PERFORATED)



△ VIEW OF DOCKSIDE AFFORDABLE HOUSING FROM THE GREENWAY LEVEL (R5)

△ VIEW OF DOCKSIDE AFFORDABLE HOUSING FROM THE GREENWAY LEVEL (R4)





## LEGEND



SMALL DECIDUOUS TREES TO BE VINE MAPLE, COLUMNAR TREES TO BE CALYPTUS AND MAPLE SIZE 3.0 M HT, 10.0 CM DBH, APPROX NO. - 50

MULTISTEM TO BE A SELECTION OF: HAZEL BARK (DEC), RED & WHITE FLOWERING DOGWOOD (DEC), CORNUS STYRACIFLORA (DEC) SIZE 3.0 M HT, 10.0 CM DBH, APPROX NO. - 10

MEDIUM SHRUBS TO BE A SELECTION OF: VIBURNUM PAUCIFLORUM (DEC), VIBURNUM BODINIERI (DEC), SYCAMORE (DEC) SIZE 3.0 M HT, 10.0 CM DBH, APPROX NO. - 120

SMALL SHRUBS TO BE A SELECTION OF: VINE BARK (DEC), LOW-LEAF BARK (DEC), BURNING BUSH (DEC) SIZE 1.5 M HT, 10.0 CM DBH, APPROX NO. - 120

NEW SCREEN PLANTS TO BE BLACK BARK (DEC) SIZE 3.0 M HT, 10.0 CM DBH, APPROX NO. - 10

SCREENING TREES TO BE A SELECTION OF: SALAL (DEC), KNOXWOOD (DEC), MOUNTAIN LAUREL (DEC) SIZE 3.0 M HT, 10.0 CM DBH, APPROX NO. - 10

VINES TO BE ENCLEREA (DEC) SIZE 3.0 M HT, 10.0 CM DBH, APPROX NO. - 10



EXISTING TREES TO BE PRESERVED

EXISTING TREES TO BE REMOVED



EXISTING PLANTING

EXISTING LOCKSTONE PAVING



LOCKSTONE PAVING AS NOTED COLOR & PATTERN TO MATCH EXISTING

CONCRETE PAVING



EXISTING LOCKSTONE PAVING

EXISTING STONE DUST PAVING

## NOTES

LANDSCAPE AREAS ARE TO BE IRRIGATED FOR ESTABLISHMENT WITH A FULLY AUTOMATIC UNDERGROUND IRRIGATION SYSTEM.

THIS DRAWING IS CONCEPTUAL ONLY AND NOT INTENDED FOR CONSTRUCTION PURPOSES.

THIS DRAWING IS FOR SOFT LANDSCAPE ONLY.

**HCMA**



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**SITE PLAN FOR PROPOSED DEVELOPMENT**  
 DATE: FEB 14, 2014  
**P1**  
 SCALE: AS SHOWN

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**WakefieldAcoustics**  
CONSULTING ACOUSTICAL ENGINEERS

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**DOCKSIDE GREEN AFFORDABLE HOUSING  
ACOUSTICAL ASSESSMENT**

**Prepared For: Catalyst Community Developments Society**

March 31, 2015



File No: 14-1998-1

**Document Revision Log**

Version	Date	Author	Reviewed by
V1 (draft)	February 19, 2015	C. Wakefield	
V2 (final)	February 20, 2015	C. Wakefield	A. Williamson
V3 (revised final)	March 31, 2015	C. Wakefield	





## EXECUTIVE SUMMARY

This noise assessment has examined the current and anticipated future noise environments at the site of an affordable housing project planned by the Catalyst Community Developments Society on Harbour Road within Dockside Green along the western shore of Victoria's Inner Harbour. The site is located on the west side of Harbour Road between the Johnson Street and Bay Street Bridges. As such the site is exposed to noise from traffic on Harbour Road as well as, at its northern end, noise from traffic on the Bay Street Bridge. Noise is also created by activities at the Point Hope Shipyards located on the eastern side of Harbour Road.

The Dockside Green MDA requires that residential developments provide indoor noise environments in compliance with Canada Mortgage and Housing thresholds, the most relevant of which is a 24-hour equivalent noise level, or  $L_{eq}(24)$  of 35 dBA, for bedrooms. The CMHC indicates that this interior noise objective will be achieved in typical residential situations (with windows open slightly for ventilation) provided that outdoor noise levels at the building facade do not exceed  $L_{eq}(24)$  55 dBA.

Wakefield Acoustics Ltd. (WAL) conducted baseline noise monitoring over a 48-hour period at three locations (see Figure 1) from October 22 to 24, 2014. This monitoring has shown that current daily average noise exposures were  $L_{eq}(48)$  54.9 dBA at monitoring Site 1 (representing the northern half of building R4), 53.5 dBA at Site 2 (representing the southern end of building R4), and 51.9 dBA at Site 3 representing building (R5).

The potential for growth in overall noise levels in the study area over time is considered very limited. Harbour Road traffic is expected to continue to be light (since nearby Tyee Road provides a more convenient route for through traffic) and any significant growth in traffic on the Bay street Bridge would be expected to be accompanied by further, more prolonged periods of congestion, with associated reductions in traffic noise emissions compared to free-flowing traffic conditions. Currently barge breaking activities occur infrequently at the shipyards but it is possible that the rate of occurrence could increase in future.

Noise levels to be experienced at the western facades of the two affordable housing buildings will be less than  $L_{eq}(24)$  55 dBA. Noise levels to be experienced at the eastern facades of the southern building R5, and the southern end of the northern building R4, are expected to be less than  $L_{eq}(24)$  55 dBA, both in the year of their completion and in the foreseeable future., Noise levels to be experienced over the majority of the eastern facade of building R4 are expected to be slightly (not more than 1 dBA) above  $L_{eq}(24)$  55 dBA. This minor exceedance would be mitigated by using standard double glazed windows that hinge along their northern edges so as to open away from the dominant noise sources located to the northeast (Bay Street bridge traffic and industrial activity).



During periods of barge breaking, the required indoor noise level can be achieved by closing the windows. This may be done comfortably because the buildings will be continuously ventilated by dual speed fans in each unit which will provide fresh air on an ongoing basis.

In summary, the noise levels that are expected to be achieved at Buildings R4 and R5 are as indicated in the following table.

**Exterior and Interior Noise Levels to be Achieved at Buildings R4 and R5.**

Location/Scenario	MDA Noise Level Targets (Outdoors)	Outdoor Noise Levels without Mitigation	Mitigation Measures	Noise Levels in Bedrooms with Mitigation Measures
Western Facades of R4 & R5	55 dBA	< 55 dBA	Not Required	≤ 35 dBA
Eastern Facades of R5 and Southern end of R4	55 dBA	< 55 dBA	Not Required	≤ 35 dBA
Eastern Facade of Majority of R4	55 dBA	55 to 56 dBA	Double-glazed windows; closed or opened from northern edge	≤ 35 dBA
Barge Breaking <sup>1</sup>	55 dBA	60 – 62 dBA	Standard windows; closed, constant ventilation	≤ 35 dBA

1., occurs infrequently.

The following measures will be taken to mitigate noise at the development:

- Installation of double-glazed, Low E, argon-filled windows having a Sound Transmission Class Rating of approximately STC 30. Such windows when closed will reduce average outdoor noise levels so as to achieve interior levels of 35 dBA or less,
- Strategic installation of windows so that they open away from dominant noise sources,
- Provision of constant ventilation via a dual-speed fan in each home, allowing for continuous fresh air even when windows are closed.
- Minimum of R20 thermal insulation in building walls,
- Majority of bedrooms located on west sides of buildings.





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## LIST OF ACRONYMS

Abbreviation/Acronym	Explanation
ANSI	American National Standards Institute
BATNEEC	Best Available Techniques Not Entailing Excessive Cost
BC	British Columbia
dB	Decibel
dBA	A-weighted decibel
EA	Environmental Assessment
Hz	Hertz
Km	Kilometre
Kph	Kilometres per hour
$L_{AFmax}$	Maximum A-weighted, fast time constant sound level
$L_d$	Daytime (7:00 to 22:00) equivalent sound level
$L_{dn}$	Day-night equivalent sound level
$L_{eq}$	Equivalent sound level
$L_n$	Night time (22:00 to 7:00) equivalent sound level
$L_{90}$	Noise level exceeded 90% of the time (background noise)
M	Metre
MDA	Master Development Agreement
MT	Metric tonnes
S	Second
SEL	Sound Exposure Level
SWL	Sound power level
WAL	Wakefield Acoustics Ltd.





## 1.0 INTRODUCTION

### 1.1 Background

In October 2014, Wakefield Acoustics Ltd. (WAL) was requested by the Catalyst Community Developments Society to conduct an investigation into the current (baseline) noise environment on the site of the Society's planned Affordable Housing Development within Dockside Green in downtown Victoria, B.C. This housing development is to be located on west side of Harbour Road, to south of the Bay Street Bridge and to the east of Tyee Road. The building site is on the west side of Harbour Road and future residences will face eastwards towards the Inner Harbour but also towards Point Hope Shipyards. The future housing site is therefore surrounded by sources traffic and industrial noise. However, existing multi-storey buildings to the west and east will provide noise shielding for the site.

The purpose of this investigation has been to document the current noise environment over the site, consider any potential changes in noise that may occur over the site within the decade following completion, compare present and future noise levels with the noise exposure limits specified in the Dockside Green Master Development Agreement (MDA), and comment on the need for any noise control measures.

### 1.2 Scope

The major tasks which have gone into this investigation have been as follows:

- Continuous monitoring of baseline noise levels at three locations on the site over a 48-hour period;
- Assessment of the representativeness of the measured baseline noise levels;
- Assessment of the potential for noise levels over the site to increase in future.
- Comparison of noise levels with requirements of the MDA;
- Recommend noise control measures as appropriate; and
- Summarize the acoustical investigation in an engineering report.

## 2.0 METHODOLOGY

### 2.1 Baseline Noise Monitoring

#### 2.1.1 Noise Monitoring Dates, Equipment and Locations

Baseline noise monitoring was conducted at three locations (sites) on the proposed housing site over a 48-hour period from Wednesday, October 22 to Friday, October 24, 2014. The monitoring was conducted using one Larson Davis Type LXT and two Larson Davis Type 812 precision sound level meters. These devices continuously sample ambient noise levels and produce full statistical descriptions of the noise environments at 15 minute intervals. The sound level meters were calibrated before and after the noise monitoring session using a Larson Davis C250 Precision Acoustic Calibrator.

The locations of the three noise monitoring sites are shown in Figure 1.

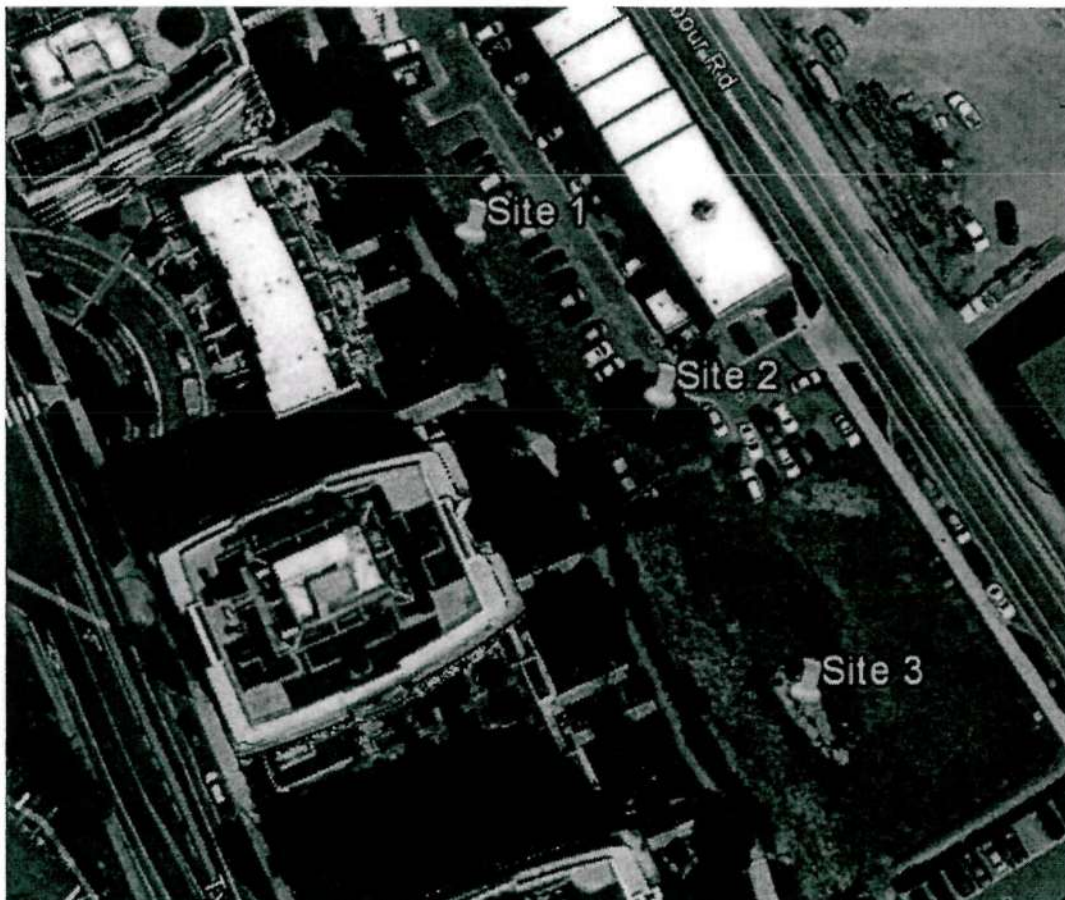


Figure 1; Locations of Baseline Noise Monitoring Sites 1, 2 and 3 (Tyee Road to the left and Harbour Road to the right).



Site 1, the most northerly monitoring site, was located directly behind (west of ) an existing three-storey building on Harbour Road and as such was expected to receive substantial shielding from noise created by Harbour Road traffic and activities at Point Hope Shipyards. Site 2 was located near the southern end of the three-storey Harbour Road building and, as such, would be expected to receive only minor noise shielding from this building. Site 3 was located in the middle of the southern portion of the proposed development, a location in which no buildings currently exist along Harbour Road and, as such, no significant shielding was provided against Harbour Road traffic noise nor Point Hope Shipyard noise.

### 2.1.2 Community Noise Metrics

The primary noise metric collected was the Equivalent Sound Level (see Glossary), or  $L_{eq}$ . When the  $L_{eq}$  is measured over a 24-hour period, the 24-hour Equivalent Sound Level, or  $L_{eq}(24)$ , is obtained. The  $L_{eq}(24)$  is the noise metric utilized in the City's Dockside Green MDA. The monitoring also provided other community noise descriptors, some of which have been plotted along with  $L_{eq}$  in the 24-hour noise level histories (two for each site) presented in Appendix B. The additional noise metrics shown are the maximum noise level measured in each 15-minute interval, i.e., the  $L_{max}$ , and the 90% Exceedance Level, or  $L_{90}$ . The  $L_{90}$  is that noise level, which over a given 15-minute period, was exceeded for 90% of the time. The  $L_{90}$  is representative of the background noise level, i.e., the level of noise that is almost always present.

## 2.2 Noise Exposure Limits contained in MDA

Schedule E, Noise Nuisance and Mitigation Measures, of the Dockside Green MDA contains limits for the noise levels to be experienced within residential units (due to exterior noise sources) to be developed within Dockside Green. These limits replicate those found within the Canada Mortgage and Housing 1986 document "Road and Rail Noise; Effects on Housing" and are as follows:

- |   |                          |
|---|--------------------------|
| • Bedrooms  | $L_{eq}(24)$ 35 dBA,     |
| • Living rooms and Dining Rooms, Recreation Rooms | $L_{eq}(24)$ 40 dBA, and |
| • Kitchens, Bathrooms, Hallways                   | $L_{eq}(24)$ 45 dBA.     |

## 2.3 Assessment of Potential Growth in Noise over Time

In assessing the noise environments at a planned residential development, it is necessary to not only establish the baseline, or pre-project, noise environment but also to consider (to the extent permitted by available information) how noise exposures may be expected to change over time. This is necessary so that appropriate residential noise environments may be achieved, both upon project completion, and in the foreseeable future. In the case of the planned affordable housing development on Harbour Road current, a potential source not captured by the baseline noise monitoring of October 22 to 24, 2014 is barge breaking at Point Hope Shipyards. This activity is currently infrequent but could possibly increase at times in the future. This assessment has considered such a possibility.

## 3.0 RESULTS

### 3.1 Baseline Noise Levels

The 24-hour baseline noise level histories obtained between October 22 and 24, 2015 at each of Sites 1, 2 and 3 are shown in Figures B.1 through B.6 in Appendix B. Reviewing these noise levels histories (which are plotted in 15-minute intervals), it may be seen that the patterns of noise level variation with time of day are quite consistent among the three sites, with average noise levels (15-minute  $L_{eq}$ ) ranging from 50 to 60 dBA during the daytime and falling to between 40 and 50 dBA during the evening and night time hours. A general trend may also be seen for average noise levels to decrease by several decibels just after 4 PM. Since urban traffic volumes do not begin to decrease this early in the afternoon, it is expected that this effect corresponds to the cessation of work at Point Hope Shipyards and perhaps other Inner Harbour Industries. Table 1 summarizes the results of baseline noise monitoring at the three sites.

**Table 1; Summary of Baseline Noise Monitoring Results**

Site No.	$L_{eq}$ (24) Oct. 22-23, 2014 (dBA)	$L_{eq}$ (24) Oct. 23-24, 2014 (dBA)	48-Hour Average $L_{eq}(48)$ (dBA)
1	55.2	54.5	54.9
2	53.2	53.7	53.5
3	51.5	52.3	51.9

While Site 1 would have received the greatest amount of building shielding from the noise of Harbour Road traffic, and presumably Point Hope Shipyard activities, Table 1 shows that its average noise exposure was in fact 1.4 dBA higher than that at Site 2, and 3 dBA higher than that at Site 3. There are several factors that may have played a role in these outcomes:

- During the noise monitoring period, Harbour Road was closed at its south end due to Johnson Street Bridge construction. Therefore traffic volumes on Harbour Road, which are normally very low, were reduced during the monitoring;
- Activity levels at Point Hope Shipyards were typical, and no particularly noisy activities such as barge breaking were being undertaken;
- The activities of people (and vehicles) accessing the parking lot behind the three-storey Harbour Road building would have made small contributions to the average noise exposures at Sites 1 and 2 but not at Site 3;
- The three monitoring sites are quite well shielded by buildings and/or terrain from the noise created by traffic on Tyee Road and on the Johnson Street Bridge; and
- Only Site 1 had an unobstructed view towards a portion of the Bay Street Bridge.

Based on the above observations, it is concluded that the main reason that noise exposures were higher at Site 1 was its exposure to Bay Street Bridge traffic noise. Traffic volumes on the Bay Street Bridge would not be expected to begin to diminish until after about 5:30 PM and,



in fact, would be expected to peak during the afternoon rush period from about 4:00 to 5:30 PM. As traffic volumes on the bridge peak, average vehicle speeds decrease due to congestion effects and overall traffic noise emissions are expected to decrease. This may be at least partially responsible for the observed drop in noise levels at Site 1 just after 4:00 PM.

### 3.2 Effects of Harbour Road Closure on Measured Noise Levels

Due to Johnson Street Bridge construction, Harbour Road was closed to through traffic at its south end during the entire noise monitoring period, so that only local traffic (accessing Dockside Green, Farmer Construction, Point Hope Shipyards etc.) would have been present on Harbour Road at that time. The size of this local traffic component is not known but it would appear reasonable to consider that it would be approximately half the normal traffic volume as Harbour Road does not function as a through road.

Carl Wilkinson of the City of Victoria's Transportation Department indicated that, while no traffic count data is available, current Harbour Road traffic volumes are very low and could be conservatively estimated at 2,000 vehicles per day (vpd). If, as assumed above, 50% of this traffic, or 1,000 vpd, was absent during the noise monitoring period, then it may be estimated<sup>1</sup> that this missing Harbour Road traffic (with a posted speed of 50 kmph and an estimated 2% heavy vehicles) would itself contribute a daily average noise exposure at Site 3 (approximately 38 m from the centre of Harbour Road) of approximately  $L_{eq}(24)$  46 dBA.

Therefore, if Harbour Road had been open to normal traffic during the baseline noise monitoring period, it may be estimated that the daily average noise level at Site 3 would have been increased from 51.9 to 52.9 dBA. Site 2 is partially shielded from Harbour Road but its average noise level would be expected to increase slightly—from 53.5 to approximately 54.0 dBA. Site 1 is partially shielded from Harbour Road traffic noise and is considered to receive most of its noise exposures from Bay Street Bridge traffic. Therefore, the current average noise level at Site 1 of  $L_{eq}(24)$  54.9 dBA would not be expected to change significantly with the return of normal traffic volumes to Harbour Road.

### 3.3 Potential Increases in Noise Exposure over Time

Changes in daily average noise exposures at the development site over time are expected to be principally associated with the following:

- Growth in traffic volumes on Harbour Road;
- Growth in traffic volumes on the Bay Street Bridge; and
- Variation in activity levels at Point Hope Shipyards.

<sup>1</sup> Using the traffic noise prediction procedure contained in the CMHC's Road and Rail Noise; Effects on Housing.

### **3.3.1 Harbour Road Traffic Growth**

Because Tyee Road provides a more direct connection between downtown Victoria (via the Johnson Street Bridge) and the Skinner Street/Bay Street and Craigflower Road corridors, it is not expected that there will be significant growth in through traffic on Harbour Road in future. There will be some growth associated with the build out of Dockside Green (of which this project is a part) but this is not expected to result in increases in Harbour Road traffic that will have significant effects on noise emissions since, all else being equal, a 100% increase in traffic volumes is required on a given road to increase its average noise output by 3 dBA. For example, if over ten years, traffic on Harbour Road was to increase by 30%, the average noise emissions from this traffic stream would increase by only 1 dBA.

### **3.3.2 Bay Street Bridge Traffic Growth**

Based on the City of Victoria's traffic count map, in 2011 the Bay Street Bridge carried approximately 22,000 vpd on its two lanes. As a result, there is substantial congestion, particularly during rush hours. Therefore, while there may well be growth in traffic volumes on the bridge in future, this growth would be expected to result in longer periods of congestion (and associated reduced noise emissions) and hence little if any increase in daily average traffic noise emissions from the bridge.

### **3.3.3 Point Hope Shipyards – Barge Breaking Noise**

Noise emissions from Point Hope Shipyard by nature have greater potential for day-to-day variation than do those from busy roadways. The overall noise emissions from the shipyard will vary somewhat with the nature and volume of work being actively undertaken. The level of shipyard activity during the October 22 to 24, 2015 baseline noise monitoring period was judged by WAL staff to be fairly typical. This was subsequently confirmed by Point Hope Marine's General Manager, Hank Bekkering who felt that activity levels during the three day monitoring period were representative of typical shipyard conditions, with no unusually noisy activities such as barge breaking.

It is recognized that one particular shipyard activity, barge breaking, creates noise at considerably higher levels and of a more intrusive character, than normal shipyard work and that this noise has resulted in the City receiving complaints from Dockside Green residents in the past. City staff have reported that this type of activity occurs very infrequently, more specifically on only two or three occasions over the past few years. That said, barge breaking is a permitted activity on the adjacent lands and it is possible that its frequency of occurrence could increase in future. Therefore the intermittent presence of such noise has been recognized in this assessment.

Noise measurements conducted in 2010 and 2011 both by City By-law Enforcement officers and by Wakefield Acoustics Ltd. showed that active barge breaking created average noise levels of  $L_{eq}$  59 to 61 dBA at a location approximately 15 m west of Site 3.



### 3.3.4 Effects of “Buffer” Buildings

The existing three-storey commercial building (C1-2) located between proposed affordable housing building R4 and Harbour Road currently acts to reduce the levels of Harbour Road traffic noise and Victoria Shipyard noise reaching this future residential site. The shielding effects of building C1-2 have then resulted in the baseline noise levels measured at Site 1 being lower than they would have been in the absence of this “buffer” building. A smaller noise shielding effect will have been created at Site 2 by building C1-2.

Similarly if, in future, commercial building C1-3 should be constructed between affordable housing building R5 and Harbour Road, it will reduce the exposure of this residential building to noise from Harbour Road traffic and shipyard activities. Notably, building C1-3 would act to shield both buildings R5 and R4 from noise created by barge breaking, which in the past has taken place just south of the large shipyard building located directly across Harbour Road from the site of C1-3.

## 4.0 DISCUSSION AND CONCLUSIONS

### 4.1 Noise Exposures at Residential Facades

Based on the analyses described in Sections 3.2 and 3.3, the future (post-construction) noise exposures at the facades of the planned affordable housing buildings (R4 and R5) may be expected to be very similar to the baseline noise levels measured at Sites 1, 2 and 3 in October 2014. The only expected differences are that levels at Site 2 and 3 may be approximately 0.5 dBA and 1.0 dBA higher respectively when the noise contributions of the absent Harbour Road through traffic are included. With this additional Harbour Road traffic included, post-construction noise levels at the three monitoring sites, and hence at both proposed buildings, are expected to be less than, or essentially equal to, the CMHC’s exterior residential noise exposure threshold of  $L_{eq}(24)$  55 dBA.

The potential for noise exposures at these residential facades to increase over time due to foreseeable growth in traffic volumes and general activity levels in the area is considered very limited. Without major changes in the nature and/or location of shipyard activities or other industrial waterfront activities, increases in long-term average noise exposures would not be expected to exceed 1 decibel over the next decade.

### 4.2 Achieving Required Interior Noise Levels

From the floor plans, it appears that the east-facing facades of all residential units will include one or more bedrooms and/or a studio/sleeping space. The units will not have balconies or decks on their east-facing facades.

The CMHC’s outdoor noise threshold of  $L_{eq}(24)$  55 dBA, as well as the indoor limit of  $L_{eq}(24)$  35 dBA for bedrooms contained in both the CMHC document and the Dockside Green MDA, are

related to the prevention of significant sleep disturbance by exterior noise. Quasi-continuous noise (such as from distant traffic, industry or general urban "hum") which does not exceed 35 dBA in the bedroom is considered compatible with sleep. To achieve 35 dBA inside a bedroom with the window open slightly, the noise level outside should not exceed  $L_{eq}(24)$  55 dBA. This requirement is based on two standard assumptions:

1. The typical reduction between outdoor and indoor noise levels that is achieved when a window is open slightly, is approximately 15 dBA,
2. During the night time (when most people are sleeping), exterior noise levels in urban areas are typically 5 dBA to 10 dBA lower than the 24-hour daily average noise level.

Where exterior noise levels will exceed  $L_{eq}(24)$  55 dBA, the CMHC recommends, and the City requires, that measures will be taken in the design of the building facades to achieve sufficient sound insulation so that interior noise levels will comply with MDA requirements, here the most relevant being  $L_{eq}$  35 dBA for bedrooms.

Noise levels to be experienced at the western facades of the two affordable housing buildings will be less than  $L_{eq}(24)$  55 dBA. Noise levels to be experienced at the eastern facades of the southern building R5, and the southern end of the northern building R4, are expected to be less than  $L_{eq}(24)$  55 dBA, both in the year of their completion and in the foreseeable future., Noise levels to be experienced over the majority of the eastern facade of building R4 are expected to be slightly (not more than 1 dBA) above  $L_{eq}(24)$  55 dBA. This minor exceedance would be mitigated by using standard double glazed windows that hinge along their northern edges so as to open away from the dominant noise sources located to the northeast (Bay Street bridge traffic and industrial activity).

During periods of barge breaking, the required indoor noise level can be achieved by closing the windows. This may be done comfortably because the buildings will be continuously ventilated by dual speed fans in each unit which will provide fresh air on an ongoing basis.

In summary, the noise levels to be achieved are as indicated in Table 2 below.



**Table 2; Exterior and Interior Noise Levels to be Achieved at Buildings R4 and R5.**

Location/Scenario	MDA Noise Level Targets (Outdoors)	Outdoor Noise Levels without Mitigation	Mitigation Measures	Noise Levels in Bedrooms with Mitigation Measures
Western Facades of R4 & R5	55 dBA	< 55 dBA	Not Required	≤ 35 dBA
Eastern Facades of R4 and Southern end of R5	55 dBA	< 55 dBA	Not Required	≤ 35 dBA
Eastern Facade of Majority of R4	55 dBA	55 to 56 dBA	Double-glazed windows; closed or opened from northern edge	≤ 35 dBA
Barge Breaking <sup>1</sup>	55 dBA	60 – 62 dBA	Standard windows; closed, constant ventilation	≤ 35 dBA

1., occurs infrequently.

### 4.3 Mitigation Measures

The following measures will be taken to mitigate noise at this development:

- Installation of double-glazed, Low E, argon-filled windows having a Sound Transmission Class Rating of approximately STC 30. Such windows when closed will reduce average outdoor noise levels so as to achieve interior levels of 35 dBA or less,
- Strategic installation of windows so that they open away from dominant noise sources,
- Provision of constant ventilation via a dual-speed fan in each home, allowing for continuous fresh air even when windows are closed.
- Minimum of R20 thermal insulation in building walls,
- Majority of bedrooms located on west sides of buildings.

## Statement of Limitations

This report was prepared by Wakefield Acoustics Ltd based on research and fieldwork conducted by Wakefield Acoustics Ltd for the sole benefit and exclusive use of the Catalyst Community Developments Society. The material in it reflects Wakefield Acoustics Ltd's best judgement in light of the information available to it at the time of preparing this report. Any use that a third party makes of this report or any reliance on or decision made based on it is the responsibility of such third parties. Wakefield Acoustics Ltd accepts no responsibility for damages, if any, suffered by any third party as a result of decisions made or actions taken based on this report.

Wakefield Acoustics Ltd has performed the work as described in the relevant contract and made the findings and conclusions set out in this report in a manner consistent with the level of care and skill normally exercised by members of the consulting engineering profession practicing under similar conditions at the time the work was performed.

This report was prepared by Wakefield Acoustics Ltd., and represents a reasonable review of the information available to Wakefield Acoustics Ltd within the established scope, work schedule and budgetary constraints of the contract.

In preparing this report, Wakefield Acoustics Ltd has relied in good faith on information provided by others as noted in this report and has assumed that the information provided by those individuals is both factual and accurate. Wakefield Acoustics Ltd accepts no responsibility for any deficiency, misstatement or inaccuracy in this report resulting from the information provided by those individuals.

The liability of Wakefield Acoustics Ltd in relation to the work conducted shall be limited to injury or loss caused by the negligent acts of Wakefield Acoustics Ltd. The total aggregate liability of Wakefield Acoustics Ltd related to this agreement shall not exceed the lesser of the actual damages incurred or Wakefield Acoustics Ltd's total fees for services rendered on this project.

## Closure

This report was prepared by:



Clair W. Wakefield, M. A. Sc., P. Eng., President

This report was reviewed by:



Andrew Williamson, P. Eng.



## Glossary

### ***A-weighted Sound Level (dBA)***

The human ear/brain system is much more sensitive to sounds at mid-range and higher frequencies (or pitches) than at lower frequencies. Sound level meters are equipped with electronic filtering (or weighting) networks that replicate the ear's frequency sensitivity. The most widely used such weighting network is called the A-weighting and sound levels measured with this weighting in place, are expressed in A-weighted decibels, or dBA.

### ***Ambient/existing level***

The pre-project noise or vibration level.

### ***C-weighting***

The C weighting provides a more discriminating measure of the low frequency sound pressures than what is provided by A-weighting. As well, unlike the A-weighting, the C-weighting is sensitive to sounds between 100 and 1000 Hz. It can be written as dBC.

### ***Daytime Equivalent Sound Level, or Ld***

The Ld is the equivalent sound level measured or computed over the 15 standard daytime hours between 07:00 and 22:00 hours,

### ***Day-Night Average Sound Level, or Ldn***

The Day-Night Average Sound Level, or Ldn, is a variation of the Leq(24) which reflects

the greater sensitivity to residential communities to intrusive noise during the night-time. In computing Ldn, a 10 dBA penalty is applied (added) to all noise levels measured or predicted to occur between 22:00 and 07:00 hours.

### ***Equivalent Sound Level***

Equivalent Sound Level, or Leq, is that steady sound level which, over a given time period, would result in the same overall sound energy exposure as would the actual time-varying community noise level. Expressed in units of dBA.

### ***Exceedance Levels***

The Exceedance Levels, or Le, provide statistical descriptions of the community noise environment. Le is that noise level which, over a given time period, was exceeded for "e" percent of the time. For example, the L10, is that noise level which was exceeded for only 10% of the monitoring time (that is, the upper decibel level), the L50 is the level exceeded for 50% of the time, or the Median Level, while the L90 is the sound level exceeded for 90% of the time (that is, the lower decibel level), often considered to represent the "background noise level".

### ***Frequency***

The rate at which the air pressure fluctuations (which constitute sound) occur. This is generally the same rate at which the sound source (say a bell) is vibrating.

Frequency is expressed in units of cycles per second or Hertz (Hz.).

***Impulsive Noise***

Impulsive, or impact, noise, such as from hammering, metal forming, pile driving, dog barking or some forms of music, is characterized by a rapid rise and then fall in noise levels, in which the duration of the noise event is brief compared to the period, or interval, between the noise events.

***Loudness***

The subjective impression of sound intensity or sound level. For a given noise, subjective loudness roughly doubles with each 10 dBA increase in sound level.

***Night-time Equivalent Sound Level, or  $L_n$***

The  $L_n$  is the equivalent sound level measured or computed over the 9 standard night-time hours between 22:00 and 07:00 hours,

***Noise***

When "sound" becomes "noise" is a subjective matter, as one person's music may be another's noise. Some sounds, such as a "jackhammer" may be considered noise by almost everyone, while others, such the sound of a motorcycle or hot rod car, may not. In general, noise may be considered to be "unwanted sound".

***Pitch***

The subjective impression of sound frequency.



# APPENDICES

Engineering Solutions  
for a Noisy World



## APPENDIX A

### Community Noise Fundamentals and Descriptors

#### Noise Fundamentals

##### *What is Sound and How is it Made?*

Vibrating surfaces such as engine housings, drumheads or loudspeakers and rapidly moving fluids such as in jet engine exhausts, produce minute fluctuations in atmospheric, or air, pressure. These pressure fluctuations spread out from the source in the form of expanding pressure waves in the air, much as a water wave on a pond spreads out from the point where a pebble has been dropped – their intensity steadily decreasing with distance from the source. Our ears, acting like microphones, sense these air pressure fluctuations and our brain interprets them as sound.

##### *The Sound Pressure Level or "Decibel" Scale*

The ear is capable of sensing sound, or "hearing", over an enormous range of intensities - from the faintest rustling of leaves to the roar of a nearby jet aircraft. The jet may produce sound that is one million times more intense than the rustling of leaves. Therefore, similar to the "Richter" scale which compresses the entire range of earthquake magnitudes into a 1 to 10 scale, the "Sound Pressure Level" or "Decibel" scale was developed to represent the even greater range of audible sound intensities within a compressed, or "logarithmic", scale. Within this scale, a Sound Pressure Level (SPL) of 0 decibels (dB) represents the threshold of hearing in the ear's most sensitive frequency range, while the

thresholds of tickling or painful sensations in the ear occur at 120 to 130 dB. The accompanying poster shows the Sound Pressure Levels, or more commonly "sound levels", typically created by a variety of common sources in the community. Roughly speaking, each 10 dB increase in sound level corresponds to a "doubling of subjective loudness".

##### *How is Sound Measured?*

Sound is measured with instruments called "Sound Level Meters" which consist of a microphone in conjunction with an electronic amplifier, a display meter and commonly today, a digital memory for logging sound level data over time. These meters are calibrated before each use.

##### *The Frequency or "Pitch" Sensitivity of the Ear - "A"-weighted Decibels*

The normal range of sound frequencies audible to the young, healthy ear is from 20 cycles per second, or Hertz (Hz.) to about 20,000 Hz. The ear is much more sensitive to mid and higher frequencies (particularly the 500 to 4000 Hz, range) than to lower frequencies. To approximate the ear's frequency sensitivity, Sound Level Meters contain electronic weighting networks, the most widely used and appropriate for typical measurements in the community being the "A-weighting". Sound levels measured with this weighting in effect are called "A-weighted sound levels" and their unit of measurement is the "A-weighted decibel, or dBA".

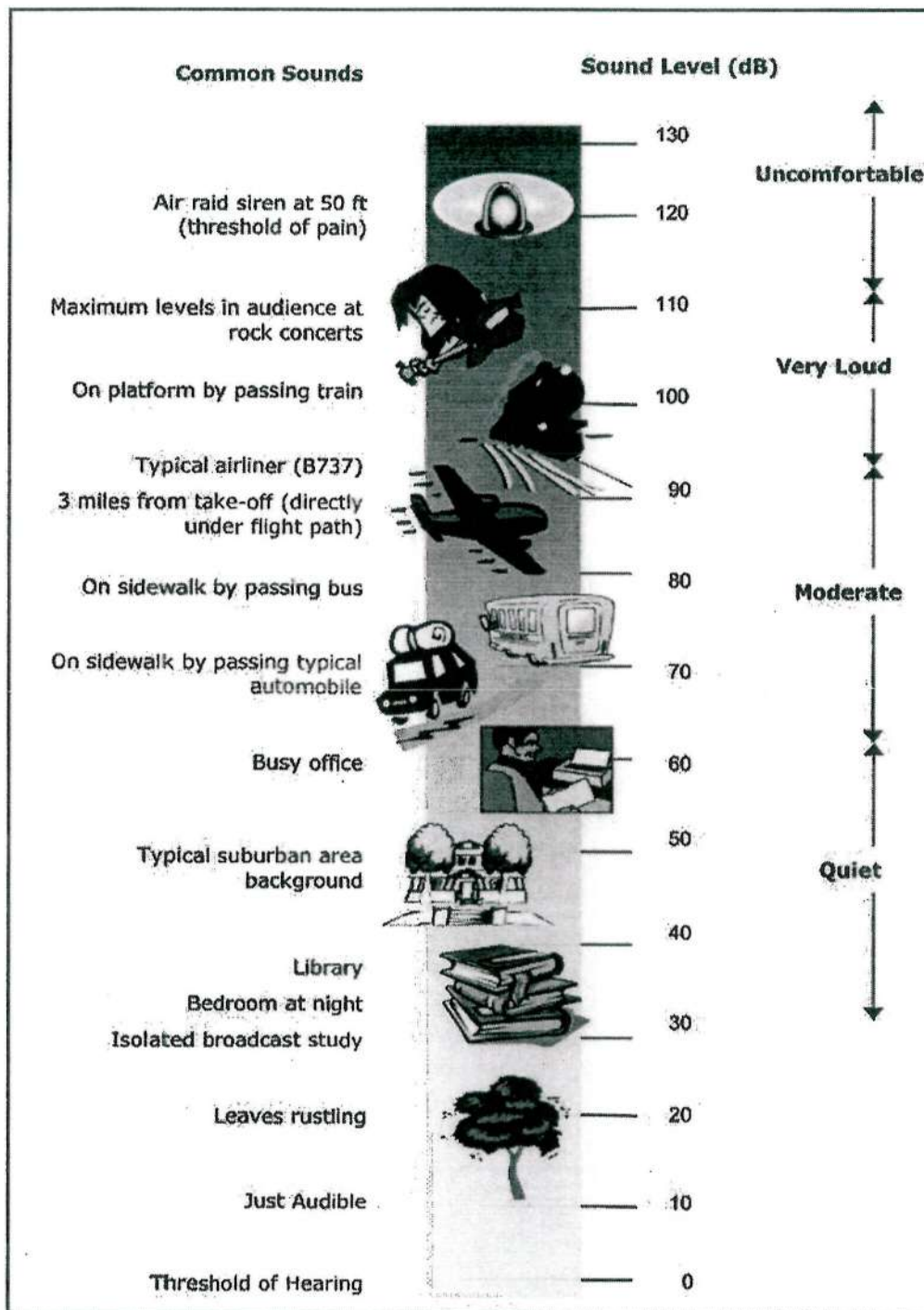




### ***What is Noise?***

Noise is commonly referred to as “unwanted sound”, because it interferes with human activities and/or creates annoyance. The judging of sound as noise is

then, to a substantial degree, a personal or subjective matter since it depends on the situation, the activities engaged in as well as individual attitudes and sensitivity.





## **APPENDIX B**

### **Baseline Monitoring Noise Levels Histories**



