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REPORT

Building Envelope Condition Assessment – Riverside Gardens

Vancouver, British Columbia

Presented to:

The Owners, Strata Corporation LMS 1978

c/o Ms. Kim Birck
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PREFACE

Terminology & Glossary

A number of the terms are used in the report that have specific meaning in the context of this report and are therefore defined below. All of the terms and abbreviations used are standard in the industry, but the glossary may be of some aid for those not familiar with construction terms:

Air Barrier refers to a combination of materials and components, including joints, that control the flow of air through an assembly, limiting the potential for heat loss and condensation due to air movement.

Balcony refers to a horizontal surface exposed to the outdoors, but projected from the building so that it is not located over a living space.

Base Coat refers to the initial wet state material, either factory or field-mixed, used to encapsulate the fibreglass reinforced mesh (EIFS applications).

Building Envelope refers to those elements of the building that separate inside conditioned space from outside unconditioned space, and includes walls, windows, doors, roofs, balcony decks (over occupied living space) and foundations. Sometimes referred to as "building enclosure" or an "environmental separator" in Building Codes.

Building paper refers to a breather-type asphaltic sheathing paper which is rated in minutes (15, 30 and 60 minutes); based on preventing water flow through it for number of minutes in accordance with a standard test.

Built-up Roof refers to a waterproof system constructed of mutiple felt layers mopped down with bitumen.

Capillary break refers to the gap between parallel layers of material sufficient to break the surface tension of water, which is typically a minimum of 3/8".

Cladding refers to a material or assembly that forms the exterior skin of the wall and is exposed to the full force of the environment. Cladding types included are stucco, EIFS, metal panels, wood siding, and vinyl siding.

Control joint or Movement Joint, refers to a continuous joint in a structure, cladding or other element, used to regulate the amount of cracking and separation resulting from relative movement.

Deck refers to a horizontal surface exposed to the outdoors, located over a living space, and intended for moderate use but not for access to other areas of the building.

Delamination refers to a separation along a plane parallel to the surface.

Drained Cavity (also rain-screen) refers to a design strategy whereby a positive drainage plane is created immediately behind the exterior cladding material, sufficient in width to break the surface tension of water and allowing incidental water entering the wall system to drain by gravity with the aid of flashings and membranes.

Drip edge refers to a projection detailed to direct water run-off away from wall, window, balcony or roofing element.

Efflorescence refers to the dissolved salts in the material (such as concrete or brick) being transported by water, and redeposited after evaporation and drying.

EIFS refers to Exterior Insulated Finish System and generally consists of layers of rigid insulation adhered or fastened to the substrate, and finished with thin coats (lamina) of reinforced cementitious material and a finish coat of acrylic stucco.

EPDM (Ethylene Propylene Diene Monomer) refers to a waterproofing sheet membrane made of vulcanized rubber. These membranes, usually single-ply applications, may be installed fully bonded to the substrate with an adhesive, or may be "loose-laid" with only the laps and terminations of the membranes adhered.

Face-seal refers to a building envelope strategy where the performance of the wall is dependent on the ability of the exterior surface of the cladding, windows, and associated sealant to shed water and prevent any water infiltration. This system can not easily accommodate water that penetrates past the exterior face since no positive drainage path or additional continuous barrier to water penetration are provided.

Finish Coat refers to the final wet state material, which provides color and texture, applied over the reinforced base coat (EIFS applications).

Fishmouth refers to a deficiency in the installation of waterproofing membranes (roofing, self-adhering membranes etc.) which results in a fold in the edge of the membrane, through which water can penetrate.

Flashing refers to sheet metal or other material used in roof or wall construction and designed to shed water (typically sloped outwards and with a drip edge to shed water). Used in conjunction with:

- **Cap (or parapet) flashing:** top of wall (at roof), pier, column or chimney

- **Saddle flashing:** an upturn, sloping transition piece between a horizontal and vertical plane, i.e. balcony cap and wall intersection.
- **Head/sill flashing:** at head or sill of window opening or other penetration
- **Base flashing:** at bottom edge of wall surface
- **Cross cavity flashing:** a flashing which sheds water from the weather barrier plane to the exterior wall plane (at floor level)

Gum lip refers to a method of sealing a metal flashing to a wall surface whereby the top edge of the metal flashing is bent outwards to form a caulk-filled cavity (typically at the termination of a waterproofing membrane).

Housewrap refers to a sheet plastic material which is used as a sheathing paper, generally between the wall sheathing material and the exterior cladding. Although recognized as a proprietary term, in this report housewrap is used to represent a generic group of materials. One common type of housewrap consists of Spun-Bonded Polyolefin (SBPO), another is made of perforated polyethylene. Their resistance to liquid water is high, but resistance to water vapour is lower than many common "vapour barrier" materials.

Maintenance refers to a regular process of inspection of envelope elements and exterior systems such as roof, walls, windows, gutters, downspouts and drains, cleaning of those items as required on a regular basis (such as leaves from gutters and drains in the fall, and cleaning lint from dryer vents), and reinstating failed elements such as areas of cracked caulking or peeling paint.

Movement Joint refers to a joint in the building envelope which allows differential movement of portions of the building structure (expansion joint), or prevents or localizes cracking of brittle materials such as stucco, where movement needs to be controlled (control joint).

Operation of the building or envelope refers to normal occupancy of the building where the envelope is affected by interior space conditioning, changes to light fixtures, signs, vegetation and planters, and accidental damage or vandalism.

Penetration refers to a hole passing through the building envelope in which ducts, electrical wires, pipes, and fasteners are run between inside and outside.

Punch window refers to the architectural style of the window being expressed as a single "punched" opening surrounded by the cladding material, as opposed to being arranged in vertical or horizontal strips of several window units.

Saddle refers to the transition of small horizontal surfaces, such as the top of a balcony guardrail or parapet wall, with a vertical surface, such as a wall.

Scupper refers to a metal pipe or trough section creating a drainage overflow from a roof or balcony to a downpipe or to a surface below.

Sheathing refers to a material (typically OSB [Oriented Strand Board], plywood, or gypsum board) used to provide structural stiffness to the wall framing and to provide structural backing for the cladding and sheathing paper.

Sheathing Paper refers to a material or combination of materials in an exterior wall whose purpose is to retard penetration of incidental water further into the wall structure once past the cladding. Commonly-used materials are building paper and housewrap.

Spall refers to a fragment of material, such as concrete or masonry, detached from a larger mass by a physical blow, weather action, internal pressure or efflorescence within the mass (sub-flourescence).

Strapping refers to the use of wood or metal strapping material (typically ¾" nominal thickness) to form a drainage cavity and act as a capillary break behind the cladding material.

Surfactant refers to an agent (e.g. detergent) that when mixing with water breaks the surface tension of water drops, thus enabling easier absorption of water through a material. Without surfactants, water would have a greater tendency to remain as drops on the surface of a given material.

Symptoms refers to visual evidence such as staining and wetting of surfaces, loss of strength, delamination or cracking of materials, peeling paint and debonded coatings, etc.; which suggests a performance problem within the exterior envelope of a building.

UV refers to ultra violet radiation (from the sun), which has a degrading effect on many membrane and sealing materials (asphaltic based) unless protected by an appropriate shielding layer.

Vapour retarder refers to a material having a high resistance to water vapour diffusion that is located within the assembly to control the flow of vapour and limit the potential for condensation due to diffusion.

Weephole refers to an opening placed in a wall or window assembly to permit the escape of liquid water from within the assembly. Weepholes can also act as vents.

1. INTRODUCTION

1.1 Terms of Reference

Morrison Hershfield (MH) was retained by PCI Realty Corp. (PCI), on behalf of the Owners of Riverside Gardens (Strata Council LMS 1978), to undertake an assessment of the current condition of the building envelope systems of their buildings located in Vancouver. Authorization for the study was provided in writing May 11, 1999, by Ms. Kim Birck of PCI.

The objective of this investigation was to assess the overall condition of the building envelope at the Riverside Gardens complex and to develop an implementation plan for any required remedial work or further investigations. Deficiencies reported herein are based on visual examination and selective sheathing moisture content measurements and exploratory openings taken at typical building details believed to be possible locations of water penetration. They do not represent a total listing of all locations with deficiencies nor do they imply all similar locations or items to be deficient.

1.2 Scope of Work

The scope of our services was outlined in our proposal letter to Ms. Birck of PCI, dated August 21, 1998, and is restated below for reference purposes:

1. *Review the original design documentation to become familiar with intent of the designer with respect to the exterior enclosure of your building. These documents will be useful to us in our assessment of the exterior wall cladding, balconies and roof areas in estimating quantities and budgets for the maintenance and renewals plan.*

2. *Undertake a visual examination of the building cladding elements: vinyl siding, windows, caulking, balcony and roof areas. The purpose of this examination is to identify the current condition of the various components of the building envelope, but also to identify probable locations of moisture problems for more in depth survey and exploratory work.*

3. *Undertake a selective moisture survey to identify the presence of moisture in the sheathing under the vinyl siding. The test locations will involve removal of sections of siding to expose the sheathing below and will be chosen in areas where the siding terminates at window/door openings, floor level flashings and balcony surfaces etc. The results of the moisture survey will confirm the presence*

or severity of rot which may exist behind the vinyl siding. The siding sections will be reinstated and moisture probe holes in the sheathing will be caulked.

Moisture probe surveying is ideally conducted after recent rainfall so that the subject building has had an opportunity to become wetted.

4. *Based on the results of the moisture survey, identify locations where larger exploratory openings may be warranted. Typically these openings involve lifting of cap flashings or small openings at window perimeters to confirm the presence or severity of rot at locations where the moisture probe readings may indicate high moisture content.*

5. *Where exploratory openings exhibit mold or fungi growth, samples will be taken by our site technician and forwarded to a laboratory for species identification. Our report will include the results of these tests in order to identify any toxic varieties which may require follow-up indoor air quality testing or special remediation procedures in their removal.*

6. *Develop conceptual maintenance and renewal recommendations with associated budget construction cost estimates for each element of the exterior building envelope which is likely to require action over the next five years.*

7. *Assess the priority of the various remedial work recommendations and develop an implementation plan for the next five years. This will allow you to plan and budget for these activities and hopefully eliminate the surprise of special assessments, as well as the need for less cost effective short term solutions. The plan will be discussed with the Strata Council and adapted to meet anticipated cash flow realities.*

8. *Prepare and submit a report which summarizes our assessment work and test results and presents our recommendations and prioritized budgets for remedial work over the next five years.*
   Additional investigative work associated with specific leak or moisture problem locations may be recommended if significant damage is discovered in the initial investigation which warrants more detailed follow-up work to establish a realistic repair and renewals plan. Additional indoor air quality (IAQ) testing may be recommended as a result of identification of a toxic variety of mold species.

The above scope of services does not include our involvement in the design and management of the contractors activities for any of the recommended renewals work. A proposal for this work can be provided once the renewals plan has been finalized.

Some of our findings will be based on a random sampling and specific location testing, and some of the findings will be based on a visual review of the surface conditions only.

1.3 Basic Information

MH was provided with the following background information and documents to assist us in our assessment of the condition of the building envelope systems:

- Architectural Drawings A0-01 to A8-03, prepared by Davidson Yuen Simpson Architects, dated July, 1994 - reissued for construction.
- Invoices from EPS Westcoast for remedial work performed to address specific locations of water ingress.
- Discussion with John O'Sullivan of EPS Westcoast regarding the repairs performed and the findings during the repair work.
- List of units which have reported current water ingress to the interior of the suites.
- Discussion with strata members regarding previous leaks and remedial work performed at the complex.

1.4 Moisture Probe Survey

As part of the scope of work, a selective moisture probe survey of the stucco cladding was performed in order to assess the general extent of the moisture ingress and the potential for deterioration of the wood sheathing. Moisture content (MC) readings are indicative of the amount of moisture present at the location at the time of sampling only, and are dependent upon local construction details, microclimate conditions, orientation, and material characteristics. The readings are only intended as a guide.

The moisture content (MC) of the sheathing was taken using a Delmhorst Model BD-9 moisture meter with a range from 10% to 50% MC. These meters use the electrical resistance of a material between two points, a specific distance apart, to determine the amount of moisture within the material. The presence of water lowers the electrical resistance of the wood. The higher the MC, the lower the resistance.

A moisture content of under 20% represents wood in normal (dry) conditions, and moisture damage is unlikely. A MC of about 20% to 30% represents wood with more moisture than typical and may be cause for concern, but the actual condition may be difficult to determine without exploratory openings. Given the right conditions (the

presence of oxygen, temperatures typical to the Lower Mainland, etc.) untreated wood with a MC of about 20% or more is susceptible to wood-destroying fungi. The average fibre saturation point of wood occurs at 28% MC (with variations between species typically ranging from 20% to 30% MC), at which the wood's cell walls are completely saturated, and above which water fills the cell cavities. Moisture contents above fibre saturation generally provide ideal conditions for the wood destroying fungi and deterioration of the wood may be rapid.

Environmental conditions must also be considered when analyzing moisture content readings. Only 10% of Vancouver's annual rainfall typically occurs during the summer months, and measurements taken late in the summer may not be characteristic of the yearly average state of the sheathing. Conversely, high MC readings taken after a long period of dry weather indicate an inability of the wall system to remove infiltrated water. Along with seasonal variations there are also short-term variations which depend on current and recent weather conditions which affect the wetting and drying cycles of the walls.

There is also a temperature dependence of wood moisture content with respect to the meter readings. The meter is calibrated to take accurate readings at about 20^0C, and at temperatures below this, actual moisture content will be greater than that measured. Similarly, at higher temperatures, actual wood MC will be lower than the meter readings. The relationship between temperature and the variation in actual wood MC to meter readings is non-linear, the higher the reading, the greater the difference. The MC measurements used in this report represent the meter readings, and the actual wood MC can be assumed to be equal to or slightly different than those listed. What is significant to remember is the *range* of the individual readings, in relationship to the discussion above.

Probing was performed by lifting sections of the vinyl siding and inserting the electrode pins of the moisture meter through the building paper and into the wood sheathing. A reading of the moisture content was then taken and recorded on elevation drawings. After the readings were recorded, the siding was reinstated. The insertion of the probes may also provide evidence of the structural integrity of the sheathing. Undamaged sheathing should provide solid resistance to the probes, whereas sheathing with severe moisture damage often provides little or no resistance.

1.5 Exploratory Openings

After the completion of the moisture probe survey, exploratory openings were undertaken to confirm the condition of the wood sheathing. Exploratory openings consist of removing sections of the vinyl siding to view the condition of the wall components behind. The openings were made at locations where deterioration of the

wall components was expected, based on results of visual examination and sheathing MC measurements, or at locations where construction assemblies were unknown and suspect. The openings allow better assessment as to the severity of deterioration, and the extent of remedial work that may need to be performed. After examination, the building paper was patched and the vinyl siding was reinstated.

1.6 Limitations

This review was based on visual inspection and a review of available documents. It is a basic assumption that any correspondence, material, data, evaluations and reports furnished by others are free of latent deficiencies or inaccuracies except for apparent variances discovered during the completion of this report. Unless specifically noted in this report, no testing, detailed analysis or design calculations were completed, nor were they within the scope of this review.

Any comments or conclusions within this report represent our opinion, and this opinion is based upon the documents provided to us, our field review of apparent physical conditions, specifically identified testing and our past experience. This review is limited to technical, construction and performance items.

Some of the findings herein are based on a random sampling, and some of the findings are based on a visual review of the surface conditions. Deficiencies existing but not recorded in this report were not apparent given the level of study undertaken.

In issuing this report, MH does not assume any of the duties or liabilities of the designers, builders or owners of the subject property. Owners, prospective purchasers, tenants or others who use or rely on the contents of this report do so with the understanding as to the limitations of the documents reviewed, the general visual inspection undertaken and understand that MH cannot be held liable for damages they may suffer with respect to the purchase, ownership, or use of the subject property.

2. REVIEW OF EXISTING CONDITIONS

2.1 Details and History of Building Envelope

Riverside Gardens consists of a 75-unit townhouse complex constructed in six buildings over a 2-storey concrete framed parking garage. The buildings are approximately three to four years old and the exterior walls are predominately clad with vinyl siding.

Several occupants have reported water ingress to the interior of their units. EPS Westcoast recently performed remedial work to a number of units where occupants had reported having water leaks to the interior. EPS Westcoast has indicated to MH that, in general, the water leaks were mainly due to improper lapping of building papers and that the water typically penetrated to the interior at the heads of windows. At the beginning of this assessment, MH was informed of four units where active water leaks to the interior have been reported. The occupants of all four units have reported water penetration to the interior at window locations, with one occupant also reporting a leak at the patio door. During the course of the assessment, two additional leaks were reported. One of the leaks was reported to occur at a window location and another was reported to occur at the base of a wall at a corner of the unit.

2.2 Review of Architectural Drawings

The typical exterior assemblies are indicated in the architectural drawings to be constructed as follow:

Exterior Wall Assembly:
Vinyl siding
sheathing paper
13mm (1/2") OSB (oriented strand board)
38mm x 89mm (2"x6") wood studs @ 400mm (16") o.c.
RSI 3.5 (R12) Batt insulation
1.5mm (6 mil) polyethylene vapour barrier
13mm (1/2") GWB

Balcony assembly:
Waterproof deck coating
5/8" tongue and groove plywood
tapered shims
2x10 joists @ 16" o.c.
perforated aluminum soffit

Flat roof construction:
waterproof membrane
1/2" plywood sheathing
sloped cross strapping
2"x10" wood joists
R28 batt insulation
6 mil polyethylene vapour barrier
½" gypsum wall board

Sloped roof construction:
Asphalt shingles
1/2" plywood or 1/2" OSB sheathing

The structural support of the sloped roofs is provided by either prefabricated wood trusses or 2"x4" on flat over 2"x10" wood joists.

In this report, the buildings of Riverside Gardens are referenced with numbers in accordance with the Architectural Drawings. The numbering of the buildings are as follows:

Building 1: 2723 East Kent Avenue North (units 23 to 40)

Building 2: 2728 Chandlery Place (units 41 to 55)

Building 3: 2711 East Kent Avenue North (units 1 to 11)

Building 4: 2713 East Kent Avenue North (units 12 to 22)

Building 5: 2727 East Kent Avenue North (units 56 to 65)

Building 6: 2733 East Kent Avenue North (units 66 to 75)

Refer to Photo No. 1 for the site layout of the six buildings.

2.3 Field Observations

Four site visits were made in June and July 1999. On June 10, 1999, Andy Lang of MH met a representative of EPS Westcoast, who provided information regarding the remedial work they had performed to address the reported water leaks to the interior. The visual review of the building envelope and the moisture probe survey were performed on June 17 and July 6, with Andy Lang (tech.) present for both days and Steve Harvey (tech.) of MH present on June 17. A contractor, Cambridge Exteriors, was retained to perform the exploratory openings through the cladding. The openings were performed under the direction of Andy Lang on July 15, 1999.

The weather during the days of the fieldwork was generally sunny with limited rainfall in the preceding days, although the preceding weeks and months had considerable amounts of rainfall.

2.3.1 Exterior Walls

2.3.1.1 Visual Observations

The exterior walls of Riverside Gardens are clad with vinyl siding. The siding appeared in reasonable condition, with some locations where the siding has been discoloured above fireplace vents. One location was observed where a section of the vinyl siding had been partially melted (Building 4, east elevation), and at another location, a large bulge in the siding was observed (Building 1, south elevation). Refer to Photo Nos. 2 and 3.

It is likely that the melting of the vinyl occurred during repairs performed to the building envelope. This location has both thermally fused and self adhesive membrane installed which extends from an adjacent concrete wall onto the wall sheathing behind the vinyl siding. Directly below the location of the damaged siding, self adhesive membrane has been installed over the siding and was extended onto the adjacent concrete wall. Refer to Photo No. 4. This is an inappropriate use of the membrane and is a poor attempt at repairs to the building envelope. MH is unaware whether the remedial work had been performed to address reported water leaks to the interior or to address possible visible deficiencies in the wall cladding.

Some streaks were observed on the vinyl siding below several balcony locations. Refer to Photo No. 5. The streaks are indicative of water running down the exterior face of the siding. The streaks typically occur below the balcony doors of the units above. The occupant of one unit has reported water penetrating to the interior at a patio door which is protected by a balcony above.

Horizontal wood bands have been installed at the floor levels throughout most of the complex. The bands are covered with metal flashing which extends from the wall sheathing to the outside of the cladding. The sections of the flashing are generally lapped and sealed, however, several locations lack sealant. Refer to Photo No. 6. No waterproofing was observed underneath the

metal flashing to protect the underlying wall components should water penetrate at the joints in the flashing.

Buildings 3, 4, 5, and 6 are situated lengthwise along the sloping grade; consequently, these buildings have several steps in their foundation. Where the steps in the foundation exist, there are vertical intersections of concrete and wood framed walls. Refer to Photo No. 7. These locations are highly susceptible to allowing water penetration behind the siding. Waterproofing membrane has typically been installed underneath the siding along these intersections.

In addition to the intersection of concrete and wood framed walls, there are numerous locations where water is likely to penetrate the cladding. These locations typically occur where the siding terminates at other envelope components; such as at the edges of sloped roofs, and around doors and windows, where no sealant has been applied.

At several locations, the vinyl siding extends below the level of adjacent landscaping with limited clearance between the exterior walls and the retaining walls. Refer to Photo No. 8. This construction limits the ease of maintenance and repairs to the exterior walls should remedial work be required at these locations.

2.3.1.2 Moisture Probe Survey

A moisture probe survey was performed on the exterior walls of the building in order to assess the general extent of the moisture ingress and the potential for deterioration of the wood sheathing and framing. This was not intended to be a comprehensive survey to indicate all areas affected by moisture, but rather as a statistically significant sampling of the wall areas to be used to assess the approximate extent of the problems and where they typically occur.

As part of the survey, moisture content measurements were taken of the wood sheathing at 68 locations. The results of the moisture probe survey are shown on photocopies of the elevation drawings in Figures 1 through 18, Appendix C and are summarized in Table 1, Appendix A. The moisture survey identified one location that contained moisture content greater than 30% and two locations that

contained moisture content between 20% and 30%. Sixty-five locations registered moisture content below 20%.

The results of the survey suggest that the exterior walls of Riverside Gardens are generally performing adequately and it is unlikely that significant deterioration of envelope components will result in the near future. However, there are several locations where water penetration past the cladding had been confirmed. These locations typically occurred at intersections of concrete and wood framed walls. When the siding was removed to perform the MC measurements near the intersection of the two wall types, it was observed that the installation of waterproofing membrane under the siding was inconsistent. At some locations, the membrane extended only several inches onto the wood sheathing; while at other locations; the membrane extended several feet from the intersection of the two walls. Several of the openings at these locations revealed water within the profile of the siding and wetting of the waterproofing membrane behind. At one location, deterioration of the building paper was also observed. Refer to Photo No. 9. The cause of the deterioration was not confirmed, but may have occurred during initial construction.

The removal of the vinyl siding at various locations throughout the complex revealed that the majority of the exterior walls are covered with building paper under the siding, with some walls having Tyvek housewrap instead. It was also confirmed that a few wall areas had exterior gypsum board as the wall sheathing.

2.3.1.3 Exploratory Openings

Eleven exploratory openings were made through the vinyl siding. In addition, the perforated aluminum soffit panels were removed from the underside of two balcony locations.

Locations of exploratory openings are shown on building elevations in Appendix C, Figures 1 to 18, with an Inventory of Test Openings in Appendix A, Table 2. Mold samples were taken at the exploratory opening nos. 1 and 10. The samples were sent to Paracel Laboratories for mold species identification. The results of the laboratory analysis will be provided in a letter report to follow once the lab analysis is complete.

Exploratory Opening No. 1

Refer to Photo No. 10
Building 1, south elevation
Above entry door, at a location where a bulge in the vinyl siding was observed.

- The OSB sheathing was not securely fastened to the underlying framing. A section of OSB approximately 1½ feet wide, which did not have any fasteners, had buckled out from the framing behind. Refer to Photo No. 11. The cause of the buckling was not confirmed, but may have been due to building settlement and a lack of space between sheets of sheathing to accommodate this settlement.
- Some white mold was observed on the OSB sheathing, which was otherwise dry and structurally sound at the time of the opening. The mold indicates previous wetting of the wood sheathing.
- OSB MC: 10%.

Exploratory Opening No. 2

Refer to Photo No. 12
Building 1, south elevation
Below second floor window, adjacent to third floor balcony support brace connection to exterior wall.

- The installation of the building papers was inconsistent at this location. The layering of the building paper ranged from a single layer up to four layers, in addition to a starter strip along the window sill. The first layer of building paper was lapped under the metal flashing at the floor level below, with subsequent layers of building paper lapping over.
- The OSB wall sheathing was dry and in good condition.
- OSB MC: 10% to 12%

Exploratory Opening No. 3

Refer to Photo No. 13
Building 6, south elevation
Around ground floor window, adjacent to intersection of concrete and wood framed walls at step in building foundation.

- Interior water stains were observed at the window head and sill. The staining was indicative of water ingress at the window head and subsequently splashing to the sill below. MH is unaware of any reported water leaks at this unit (unit 66).

- A single layer of building paper was installed over gypsum sheathing. Both the paper and the sheathing were wet and had deteriorated. Refer to Photo No. 14.
- Sections of the gypsum sheathing were removed at two locations, along the window jamb and near the base of the exterior wall. At both locations, a waterproofing membrane was observed behind the gypsum sheathing.
- A sample of the building paper and gypsum sheathing was collected and sent to Paracel Laboratories for mold species identification.

Exploratory Opening No. 4

Refer to Photo No. 15
Building 6, west elevation
At step in foundation wall adjacent to entry of unit 69.

- Self adhesive membrane had been installed onto the wood sheathing behind the vinyl siding. The membrane extended approximately 18" from the vertical intersection of concrete and wood framed walls.
- The OSB sheathing was dry and in good condition.
- OSB MC: 14%

Exploratory Opening No. 5

Refer to Photo No. 16
Building 5, west elevation
Below balcony, above patio sliding door.

- Water stains were observed on the perforated aluminum panels of the balcony soffit, at the connection to the exterior wall.
- A section of the aluminum soffit panel was removed, which revealed a layer of gypsum sheathing. An opening was made in the gypsum soffit to review the balcony assembly.
- The building paper and OSB sheathing of the wall area, and the wood balcony components were all dry and in good condition at the time of the opening.
- OSB MC: 10%

Exploratory Opening No. 6

Refer to Photo No. 17
Building 4, east elevation
Below second floor balcony, above patio door.

- A section of the aluminum soffit panel of the balcony was also removed to review the condition of the gypsum soffit sheathing. The gypsum sheathing was dry and in reasonable condition. No opening was made through the gypsum.
- The building paper and OSB wall sheathing were dry and in sound condition.
- OSB MC: 10%

Exploratory Opening No. 7

Refer to Photo No. 18
Building 1, north elevation
At edge of flat roof connection to exterior wall

- Up to four layers of building paper had been installed at this location. The papers lapped over the metal flashing at the floor level below.
- The OSB was dry and in good condition.
- OSB MC: 12%

Exploratory Opening No. 8

Refer to Photo No. 19
Building 2, north elevation
Below 2nd floor entry landing, around a ground floor window.

- The gutter installed along the edge of the entry landing did not have a downspout to control the flow of water within the gutter. Instead, an opening in the gutter allows any water to run down the vinyl siding of the exterior wall below. This is a typical detail for these locations.
- The building paper was lapped behind the window head flashing, contrary to good construction practice.
- The OSB sheathing was dry and in good condition at the time of the opening.
- OSB MC: 10%

Exploratory Opening No. 9

Refer to Photo No. 20
Building 3, east elevation
At step in foundation wall adjacent to entry of unit 4.

- A self adhesive membrane was installed over the OSB sheathing at the building corner. The membrane extended approximately 17" from the intersection of the concrete and wood framed walls.

- Up to three layers of building paper had been installed at this location. The outer layer of paper was lapped into the vinyl siding trim at the door jamb, which may indicate that remedial work had been performed at this location subsequent to original construction.
- The OSB sheathing was dry and in good condition.
- OSB MC: 13%

Exploratory Opening No. 10

Refer to Photo No. 21
Building 4, south elevation
Around ground floor window, adjacent to intersection of concrete and wood framed walls at step in building foundation.

- The assembly was confirmed to consist of (from the exterior): vinyl siding, building paper, gypsum sheathing, OSB sheathing.
- A waterproofing membrane was confirmed to extend onto the OSB sheathing, approximately 6" from the intersection of the concrete and wood framed walls at the building corner.
- The gypsum sheathing and building paper were soft, moldy, and wet. A sample of the gypsum sheathing was removed and sent to Paracel Laboratories for mold species identification.
- Sections of the gypsum sheathing were removed to review the underlying wall components. The underlying OSB sheathing was saturated with water, was moldy, and had deteriorated. Refer to Photo No. 22. A sample of the OSB sheathing was removed and sent to Paracel Laboratories for mold species identification.
- MH is unaware of any reports of water leaks to the interior of this unit (unit 12).
- OSB MC: 40%

Exploratory Opening No. 11

Refer to Photo No. 23
Building 6, southeast corner
Below third floor window

- The building paper and OSB wall sheathing were dry and in good condition at the time of the opening.
- OSB MC: 10%

2.3.1.4 Mold Species Samples

Samples of moldy materials were collected from exploratory opening nos. 3 and 10 (unit nos. 66 and 12) and submitted to Paracel Laboratories for analysis of species present. The significant presence of toxigenic or pathogenic molds can have great impact on the complexity and cost of remedial activities. Laboratory results identifying the mold species were not available at the time this report was completed. A supplementary letter report will be issued.

2.3.2 Windows, Doors and Other Wall Penetrations

The windows and balcony sliding doors installed at Riverside Gardens are double glazed with vinyl frames. Exposed windows have metal head flashing installed above. In general, the head flashing is not well sloped to the exterior to shed water away from the window and is not equipped with end dams to prevent laterally flowing water from penetrating behind the siding at these locations. Refer to Photo No. 24.

The vinyl siding of the exterior walls is terminated with a vinyl trim in direct contact with the window frames. The majority of these intersections do not have sealant applied to prevent water penetration past the cladding. MH is unaware whether the sealant application has been performed to address reported water ingress to the interior, or possibly as a preventative measure to limit future water penetration at selective locations. Although not confirmed, it generally did not appear that the sealant was applied with a proper joint profile utilizing a backer rod behind.

Other penetrations through the vinyl clad walls, such as vents, generally do not have sealant installed around their perimeters, and where sealant has been applied, it is doubtful that the application included a backer rod.

Also susceptible to allowing water penetration past the siding are locations where balcony supports are secured to the wood framed walls. Refer to Photo No. 25. This detail only exists on the south elevation of Building 1. The support posts are sloped back towards the building and a small section of metal flashing has been installed at the top surface of the post to prevent water flowing down the post from penetrating behind the siding. The supports are generally sheltered by the balconies above and the limited moisture probes and exploratory opening at these locations did not reveal signs of water ingress at the locations reviewed.

The entrance doors to the units are wood framed. At a few locations, the paint was observed to be peeling from the door jamb framing. Refer to Photo No. 26. The peeling paint is indicative of moisture within the wood. At a few locations some staining was observed on the exterior door head framing. Refer to Photo No. 27. The staining is indicative of water penetrating behind the cladding and door head flashing above and dripping down from between sections of the door frame.

2.3.3 Roof Assemblies

The majority of the buildings at Riverside Gardens have sloped roofs covered with asphalt shingles. Due to difficulty in accessing many of the main sloped roof areas, a brief visual review was performed at a localized area only. In general, the asphalt shingles on the sloped roof areas appeared to be in reasonable condition at the locations observed.

The majority of the sloped roofs shed water into metal gutters installed at the base of the roofs. An exception was at some of the roofs over unit entrances. Some of these locations lack gutters and, as a result, water flows down over the wood fascia at the base of the roof, causing staining of the fascia and the adjacent envelope components. Refer to Photo No. 28.

Flat roof areas are waterproofed with a built-up roofing membrane (BUR) protected with gravel cover. Based on a limited visual review of these flat roof areas, the roofing membrane appeared in reasonable condition. At the intersection of the roof and adjacent wall area, the membrane was confirmed to lap up the wall sheathing approximately 12".

A small parapet wall has been constructed along the perimeter of the flat roof areas. Refer to Photo No. 29. The parapet is covered with metal cap flashing over the roofing membrane, which laps up and over the parapet wall. The termination detailing of the membrane under the cap flashing, however, was not confirmed.

MH was requested to review the location where a satellite dish was installed, and subsequently removed, from the roof over unit 65. The dish had been fastened through the wood fascia board and it appeared that the edge of the asphalt shingles had been trimmed to accommodate the dish. Refer to Photo No. 30. The shingles have been trimmed such that they do not extend beyond the face of the fascia board at the location where the dish was installed. The remaining shingles, however, also do not extend significantly beyond the fascia, and the trimming of the shingles is unlikely to compromise the

performance of the roof. The holes in the fascia should be filled with sealant to limit the amount of rainwater that may penetrate at these locations.

2.3.4 Balconies and Decks

Balconies are waterproofed with vinyl sheet membranes. Lower floor balconies are sheltered by balconies above, while upper floor balconies are exposed. The guardrails of the balconies are metal framed with glass infill panels.

The guardrails are secured to the balcony structure with fasteners that penetrate the waterproofing membrane and are also fastened to the exterior walls through the vinyl siding. Refer to Photo No. 31. Sealant has been applied at the observed locations where the fasteners penetrate the vinyl balcony membrane. These locations are typically problematic with respect to allowing water penetration into balcony assemblies.

The main field area of the vinyl membranes of the balconies observed generally appears to be in reasonable condition. There is a concern, however, with the termination detailing of the membranes. Below the balcony doors, the membranes are lapped up to the underside of the door frames and are sealed with a bead of caulking. Refer to Photo No. 32. It is unlikely that any waterproofing membrane exists underneath the door on the sill framing. Any water penetrating through joints in the door framing or around the perimeter of the doors may potentially reach the wall, floor and balcony components which are susceptible to deterioration from exposure to high moisture contents. This membrane termination detailing at the underside of balcony doors may be the cause of the observed staining on the vinyl siding of wall areas sheltered by balconies above.

Another location which may allow water penetration is where the vinyl membrane extends from the edge of the balcony onto exterior walls. These locations generally rely on a bead of sealant at the membrane termination to prevent water ingress. At some locations, the membrane was not properly adhered to the underlying wood sheathing, and the membrane did not extend up the wall behind the vinyl siding. Refer to Photo No. 33.

The north elevation of Building 2 has concrete stairs leading up to a landing to the entry of the upper floor units. Refer to Photo No. 34. The landings have concrete topping over a waterproofing membrane. Along the edge of the landings, at the underside of the stairs, gutters have been installed to collect any water runoff from the landing. These gutters are not attached to

downspouts. Instead, a hole in the bottom of the gutters at one end allows water to drip down onto the vinyl siding of the wall below. In some locations, vents have been installed directly below the opening in the gutters, which may potentially increase the chances of water penetrating the cladding. Refer to Photo No. 35. The entry landings are sheltered by roofs above, and likely receive only limited exposure to water contact. However, water from other sources (watering plants, washing the landing area, etc.) may cause a concern with respect to water penetration at these locations.

2.3.5 Parking Garage and At-Grade Waterproofing

A visual review of the underground parking garage revealed numerous locations with signs of water penetration. These included efflorescence on the ceiling slab and concrete walls, in addition to water penetrating to the parkade during the field review. Refer to Photo Nos. 36 and 37.

MH understands that some remedial work had been performed by the original builder to address the most notable location of water ingress, which occurs near the southwest entrance to the parkade, east of Building 4. Despite the remedial work, which included excavation in the courtyard area above the parking garage and repairs to the waterproofing membrane of the courtyard, the water leaks have continued, although to a lesser extent.

3. DISCUSSION

The combination of the background information, our visual observations, moisture probe survey and exploratory openings suggests that there is a high probability for water penetration through the building envelope of Riverside Gardens. Despite this, there is little evidence to suggest that water penetration has resulted in significant deterioration of envelope components at this time.

At the time of completion of this report ten units have reported water leaks to the interior (some of which have been repaired, while others appear to be active). The exploratory openings indicated two additional units where water has penetrated the cladding and caused extensive deterioration of wall components. Because some of the locations of water ingress appear to be at typical construction details, which are repeated throughout the complex, more extensive water ingress is likely to occur in the future.

3.1 Exterior Walls

The walls of Riverside Gardens rely on a combination of the vinyl siding and underlying sheathing paper to provide the barrier to water penetration. The design intent of this cladding system is for the vinyl siding to block the majority of the water, with incidental water penetration being accommodated by the sheathing paper. Metal flashing at each floor level is designed to shed the water either at the face of the siding or the face of the sheathing paper back to the exterior. This type of wall system typically performs well in locations of low exposure to wind driven rain, and is more susceptible to failure at higher exposure conditions. Because the roof overhangs at Riverside Gardens provide only limited protection of the exterior walls, water contact with the walls is inevitable.

The sheathing paper does not provide a waterproof barrier behind the siding and is intended to accommodate only incidental moisture ingress. The sheathing paper is not waterproof and combined with the many penetrations through the sheathing paper, is susceptible to allowing water penetration to the wall components behind. It is often at specific construction details where the amount of water penetrating the cladding exceeds that which can be shed by the sheathing paper. This results in leaks to the building interior and deterioration of envelope components. Therefore, it is essential that the vinyl siding be designed as the primary barrier to water penetration.

The use of sealant at Riverside Gardens is inconsistent. Sealant has been applied at many locations throughout the complex, such as around windows, vents, and at roof/wall intersections. Many other locations, however, lack sealant. To ensure that the vinyl siding performs as the primary barrier to water penetration, sealant is

required to limit the amount of moisture penetrating the cladding at the various connections between the siding and the other envelope components. A proper sealant joint requires the use of a backer rod or similar bond breaker material and support for the sealant application. Although not confirmed, it did not appear that the sealant application at Riverside Gardens utilized a backer rod.

Typical sealants used in construction have variable life expectancy, which depends on the type of sealant and the conditions in which it is installed. Because of this lack of consistency with regards to expected lifetime, all sealant should be inspected at least on an annual basis. Any signs of sealant failure, such as the sealant becoming hard and brittle, cracking, peeling, or loss of adhesion to substrate would warrant full replacement of the sealant at that location.

There are many locations at Riverside Gardens where water is likely to penetrate the vinyl siding. This has resulted in several reports of water ingress to the building interior, although, in general, it does not appear to have resulted in widespread damage to envelope components at this time. Extensive damage, however, has been confirmed at localized areas and remedial action will be necessary.

Because the vinyl siding is secured directly through the building paper and into the wood sheathing, there is limited drainage capability of this type of wall system should water penetrate the cladding. Current practice, and now a requirement by the City of Vancouver under Part 5 of the Building By-Law, is to provide a drainage cavity behind the wall cladding. This cavity improves the drainage characteristics of the wall, when water penetrates the cladding. This, in conjunction with improved waterproofing details at locations where water penetration is likely to occur, provides significant improvement to the water management capabilities of the exterior walls. The cavity is also believed to increase the drying potential of wall components should they become wet.

3.2 Windows, Doors and Other Wall Penetrations

3.2.1 Windows

Water ingress at window locations may occur between the window frame and adjacent wall cladding, or may occur through joints in the window frames themselves. The majority of the water leaks to the interior at Riverside Gardens have been reported to occur at window locations. To obtain an exact location of the water ingress, water penetration tests would be required. This could be performed as part of a second stage assessment, but is not normally necessary as it is sufficient to know that the windows leak and appropriate remedial action can be taken.

3.2.2 Vents

Dryer vents require routine cleaning to ensure that they do not become blocked with lint. Should a dryer vent become blocked, the warm, humid air that is produced by the dryer will not be properly discharged to the building exterior. When this occurs, there is a possibility that the air may penetrate through small discontinuities in the ducts and be expelled to the building interior or into the exterior wall assemblies. Should dryer exhaust be released into the exterior wall assembly, condensation is likely to occur, which may result in deterioration of the wall components.

3.2.3 Doors

The paint peeling from the wood door frames is an indication of moisture within the wood. At exposed locations, water contact with the doors will be inevitable, and periodic maintenance of the doors will be required. The water stains observed at the door head framing may be an indication of water penetrating the wall cladding above, which was not directed back to the exterior by the sheathing paper and head flashing above the door.

Swing doors and sliding doors in exposed locations should have sealant installed around their perimeters to limit the chance of water penetrating between the door frames and the adjacent vinyl siding.

3.2.4 Other Penetrations

As previously discussed, other penetrations through the exterior walls are also prone to water ingress past the cladding. Sealant is generally required at such locations to limit the amount of water that does penetrate.

3.3 Roof Assemblies

Properly installed asphalt shingle roofing can provide a durable barrier to the elements with periodic inspection and maintenance. Based on the current limited knowledge of the condition of the asphalt shingled roof areas (MH is unaware of any problems associated with the main roof areas) it is unlikely that remedial work will be necessary in the near future.

Consideration should be given to the installation of gutters at the base of the gable roofs over several of the unit entrances. Gutters and downspouts provide an efficient method of managing water from the roof areas, and the lack of gutters at these small roofs has resulted in staining of the wood fascia boards and adjacent envelope

components. Such concentrations of water runoff may also increase the likelihood of water penetrating the wall cladding at these locations.

Built-up roofing (BUR) membranes consist of successive layers of felts with hot applied asphalt between them. The top is covered with a "flood coat" of asphalt which is protected with a gravel cover. The gravel provides protection of the membrane from UV radiation and from mechanical damage.

With careful maintenance, BUR membranes have a typical service life of 15 to 17 years before significant repairs or replacement of the membrane is required. Any signs of failure of the membrane, such as ridging or blistering, will necessitate remedial action before more extensive problems result.

MH has been informed of reports of water ponding on flat roof areas. Ponding water can have damaging effects on BUR's. The roofing felts can absorb moisture which can cause the felts and asphalt to decay. The amount of water absorbed increases with the age of the roof, escalating the rate of deterioration. Water ponding can also cause hot and cool spots that may result in differential thermal movements of the asphalt and felt layers. Constant differential thermal movement and water absorption can reduce the expected life of the roof by several years.

With proper maintenance, the roofing membrane installed at Riverside Gardens should provide several more years of service before any significant repairs are necessary. When roof membrane replacement is required, likely within the next 11 to 14 years, the roof decks should be re-sloped to ensure proper drainage of water. The strata should consider using a 2-ply modified bitumen membrane for the replacement membrane, which is a pre-manufactured product and is generally accepted to be more durable than BUR's.

3.4 Balconies and Decks

Vinyl membranes utilized on exposed balconies typically have a service life of 5 to 8 years when repairs or replacement will be necessary. The vinyl balcony membranes of Riverside Gardens are likely to provide several more years of functional life before replacement is required.

There are, however, a number of suspect details associated with the balconies where water penetration may occur. These include at terminations of the membrane at doors and exterior walls, and at locations where guardrail fasteners penetrate the membranes. Vinyl membranes are not self-sealing and penetrations through the membrane may allow water ingress to the balcony assembly below. The sealant

installed at these locations is unlikely to provide sufficient waterproofing for more than a few years due to sealant failure over time.

The evidence that suggest failures of the balcony membrane include water streaks on the vinyl siding below balconies and one report of water ingress at a patio door. The two exploratory openings below balcony locations did not reveal any deterioration of wall components.

3.5 Parking Garage and At-Grade Waterproofing

Leaks into below grade structures are often difficult to trace and may be costly to repair. Injecting the concrete to seal the leaks from within the parkade is often unsuccessful at preventing further water penetration. Injection does not address the source of the leak, which is likely a deficiency in the waterproofing membrane on top of the structural slab.

Because of the time that it takes for corrosion of the reinforcing steel in the concrete to occur due to water ingress, leaks into parkades often cause more of a nuisance than a concern regarding occupant health or safety. It is possible to provide means of diverting any water that penetrates onto vehicles within the parkade. This temporary measure can allow an accumulation of funds for eventual repairs of the waterproofing membrane on the parkade slab above. The structural integrity of the slab is unlikely to become compromised due to water ingress for many years. However, this also depends on the amount of water that does penetrate into the concrete. Signs of structural distress, such as spalling of the concrete, will provide an indication that repairs to the slab will be required within the near future.

4. RECOMMENDATIONS

The following recommendations are based on visual observations and sample locations of probing and exploratory openings through the vinyl siding. Because of the general nature of this assessment, the full extent of water ingress and the resultant damage has not been determined.

4.1 Exterior Walls

For immediate concerns with respect to water ingress, MH believes two options to be viable. The first is to replace the existing cladding with a rainscreen wall system and provide improved waterproofing details at all locations typically prone to water ingress. The second option is to improve the water shedding abilities of the existing walls by use of sealant and localized repairs. The later option can not be considered a permanent solution and will require rigorous maintenance to ensure adequate performance.

4.1.1 Option 1: Exterior Wall Rehabilitation with Rainscreen System

Wall rehabilitation should include replacement of all damaged envelope components, and the installation of vertical strapping under the cladding to provide a drainage plane and capillary break between the cladding and underlying wall components. This is often referred to as a "rainscreen" wall system. At present, only limited areas of Riverside Gardens are likely to require repairs of an extent that will necessitate an upgrade to a rainscreen wall system. Due to requirements of the City of Vancouver, however, at any locations where a significant area of wall cladding requires removal, a rainscreen system must be installed. It is likely that any repairs requiring a building permit will necessitate an upgrade of the existing walls to a rainscreen system.

MH believes that this upgrade should be performed immediately wherever damage to wall components has occurred, and at all locations where remedial work to address specific leaks requires the removal of significant areas of vinyl siding. MH also recommends that the strata accumulate a reserve fund for the eventual rehabilitation of all exterior walls with a rainscreen system. With proper waterproofing details and typical routine maintenance, this type of wall system can provide an effective and durable barrier against water penetration over the long term.

The time frame at which complete rehabilitation of the existing walls will be required is difficult to predict. Based on our present knowledge of the condition of the building envelope of Riverside Gardens, MH believes that most wall areas, with proper maintenance, can provide several years of functional life.

The exterior wall rehabilitation work should include the following items:

- Remove existing vinyl siding and sheathing paper on exposed walls
- Remove exterior wood sheathing and wood wall framing as required
- Replace rotted wood areas with new wood products, pressure treating as required
- Install cross cavity flashing over the wood trim at each floor level
- Reinstate any damaged finishes resulting from previous water damage and wood replacement activities
- Place new wall sheathing paper, and self adhesive membrane to tie into all wall penetrations such as windows and vents, as well as waterproofing all wall transitions such as base and cross cavity flashing and saddle connections. Windows will need to be removed and reinstalled with nailing flange outside of new drainage cavity.
- Install all new metal flashing at base of wall, over the foundation membrane
- Place vertical wood or metal strapping to create wall cavity
- Install new vinyl siding, similar to existing, as a cladding over the vertical strapping

The unit cost for replacement of the existing wall system with a rainscreen system is estimated at $\$25/ft^2$. This estimate does not include the replacement of damaged sheathing or framing. This cost can only be determined once the wall cladding is entirely removed. As an allowance to account for damaged wood components, MH recommends budgeting an additional 20% of the wall repair costs. This assumes extensive deterioration will not be found at the time the wall repairs are performed.

At this time, we are not providing any overall costs for wall rehabilitation because the extent of necessary repairs is unknown. It appears that such comprehensive repairs will only be required at localized and limited areas.

MH recommends that an initial phase of wall rehabilitation occur at the locations where extensive deterioration of wall components has been confirmed. Two such locations exist where deterioration has been observed, with two other locations similarly constructed. These areas are located on the south elevation in generally sheltered locations, where a step in the foundation exists. MH recommends that each of these areas be reconstructed with improved waterproofing where the concrete and wood framed walls connect.

Because these localized areas may have extensive deterioration, the unit costs to repair these locations will likely be greater than the typical unit rates for exterior wall reconstruction. Closer review will be required to determine the specific waterproofing detail of the intersection between the concrete and wood framed walls and to determine whether any excavation of concrete at the landing and stairs above will be required to properly waterproof these locations. As an initial estimate, MH recommends budgeting approximately $7,500 to reconstruct these four locations. Should excavation of the concrete be required due to the extent of wall deterioration or to properly waterproof these locations, the costs for the recommended repair will increase.

4.1.2 Option 2: Prolonging Functional Life of Existing Walls

The proper application of sealant can improve the water shedding capabilities of the existing walls at Riverside Gardens. Sealant has been applied around some windows, vents, roof edges, and similar intersections of the vinyl siding with other envelope components. A consistent and thorough application of sealant at these areas can improve the existing cladding and prevent water ingress. The sealant should be installed with a proper joint profile, utilizing a backer rod or similar bond breaking material. A high quality sealant material, such as silicone, is recommended. Prior to selecting the sealant, it must be verified that the sealant to be used is compatible with the substrates on which it is installed.

Note, however, despite the application of sealant, the wall system will still be limited in the amount of water that can be accommodated by the wall components behind the vinyl siding. When failure of the sealant occurs, water ingress may occur, resulting in deterioration of the wall components. The sealant will require thorough inspection and maintenance on a routine basis.

As a budget cost, MH estimates that the installation of proper sealant joints throughout Riverside Gardens to be in the order of $75,000. This assumes all locations will require the application of sealant or those that do have sealant will have the sealant replaced. Therefore, this estimate predicts a "worst-

case" scenario requiring the replacement of the existing sealant. A more realistic budget allowance for immediate attention is approximately 60% of the above cost ($45,000). Further review will be required to provide a better indication of the number of locations requiring sealant.

The application of sealant at Riverside Gardens should begin immediately to minimize future water penetration.

4.2 Windows, Doors and Other Wall Penetrations

The application of sealant around the perimeters of all wall penetrations is discussed in wall repairs above. Windows, however, are also prone to leak through joints in the window frames. Should water penetrate at these locations, the water will likely reach the wall components behind the wall cladding, which may result in deterioration of susceptible materials. In order to address water leaks through joints in the window frames, modification to the waterproofing of the window openings is required. This work would include removal of the windows and adjacent wall cladding to allow the installation of waterproofing membrane along the window sill opening. An average cost per window of $700 is estimated to perform this work.

Prior to implementing these repairs, confirmation is required that water ingress through joints in the window frames is occurring at Riverside Gardens. This could be achieved by monitoring of the window locations, or by further investigations, including water penetration testing.

4.3 Roof Assemblies

Sloped roof areas are unlikely to require any significant repairs within the immediate future. MH does recommend, however, that gutters and downspouts be installed at the base of the gabled roofs at unit entries.

Many of these roof areas have gutters already installed, therefore, only a limited number of such locations will require action. We have not confirmed the total number of locations which lack gutters. MH recommends budgeting an allowance of approximately $1,500 for the installation of gutters and downspouts at the base of the gabled roofs. This cost includes the installation of downspouts at the gutters below the entry landing stairwells on the north elevation of Building 2 (discussed in Section 4.4).

MH is unaware of any problems with the flat roof areas, however a comprehensive review was not performed. As part of typical building maintenance, all flat roof areas should be inspected on an annual basis and localized repairs performed as required to ensure the membranes provide acceptable performance.

4.4 Balconies and Decks

MH is unaware of any current significant problems with the waterproofing of balconies. Evidence indicates that water may be penetrating at some balcony door sill locations, to the balcony or patio area below. Repair to address this water penetration will require the removal of the balcony doors to allow the installation of waterproofing membrane under the door sills to divert any water back onto the balcony membrane.. This repair procedure is estimated at approximately $700 per location, assuming no damage to wall or balcony components have resulted.

Because the severity and extent of problems at these locations have not been confirmed, we cannot provide an implementation schedule for these repairs. Future monitoring and further investigations should be performed. If this work is delayed for several years, MH recommends that it be performed in conjunction with replacement of the balcony membranes as a standard building envelope renewals item.

Downspouts should be installed to control the flow of water from gutters below the entry landings along the north elevation of Building 2. The cost for this work is included in the budget allowance for the installation of gutters and downspouts at the base of the gable roofs over unit entrances, which is described in Section 4.3.

4.5 Parking Garage and At-Grade Waterproofing

The areas of current leaks and previous repairs should be monitored to determine if an increase of water penetration is occurring, and remedial action taken as appropriate. A future proposal can be provided if it is required to investigate the extent of damage in the underground garage due to water penetration, or to determine the condition and installation of the waterproofing membrane.

4.6 Mold Samples and Testing

Samples of moldy materials were taken at two different locations at Riverside Gardens. However, laboratory results identifying the mold species are not available at this time. A supplementary report will be issued.

4.7 Building Maintenance

Some maintenance items are indicated above. All buildings require routine maintenance to ensure adequate performance of the building envelope. Among other items, a typical maintenance plan should include cleaning of gutters and downspouts, cleaning of dryer vents, inspection and replacement of sealant, and the inspection and repairs as needed to roofing and balcony membranes.

If not already in place, MH recommends that the Strata establish a maintenance schedule for the building envelope of Riverside Gardens.

4.8 Second Stage Assessment

To provide a better indication of the extent of water ingress and resultant damage to building envelope components, further assessment is recommended. This may consist of further moisture content measurements and exploratory openings to provide a better indication of the magnitude of the problems, and allow for a more realistic and phased implementation schedule for the recommended rehabilitation plan. If desired, water penetration testing can be performed to trace the source(s) of specific water leaks.

This initial assessment provides a review of the overall condition of the building envelope for the six buildings in the complex. Although most of the building envelope appears to be providing an adequate barrier to water penetration, there are several locations where water penetration has occurred. A few locations have been confirmed where deterioration of wall components has occurred as a result of this water ingress. The extent of the problems over the rest of the facility has not been determined.

Due to the number of low moisture content readings of the exterior wall sheathing, and relatively small sampling of exploratory openings, we believe that it may be possible to extend the life of the existing walls and defer the majority of wall rehabilitation work for at least several years. By performing a second stage assessment we will be able to achieve a more accurate understanding of the extent of damage, and hence a more accurate budget for immediate versus deferred repairs and rehabilitation. We believe that this would be the most cost-effective course of action.

MH recommends budgeting approximately $6,000 to $10,000 for further building envelope assessment and investigation. Please note that this budget may vary significantly, depending on the extent of investigation that is desired to address current water ingress problems. If water penetration tests at windows, etc. are required, the budget for the second assessment will be higher.

4.9 Summary of Recommendations

The remedial work recommendations are summarized in Table 3, Appendix A. The costs provided are expressed in 1999 dollars and assume proper, regular maintenance to the envelope.

For some repair elements we have indicated unit costs only, since additional surveying will be required to estimate take-off quantities of deteriorated elements.

The estimate of tasks and costs are based on our current knowledge of the condition of the envelope. However, the presence of toxigenic or pathogenic mold species can impact repair procedures and add supplementary costs.

These "order of magnitude" costs are for initial budgeting purposes only. Accurate costs for the rehabilitation plan, however, can only be obtained for work of this nature once the design, specifications and detailed tender documents is complete.

With any wall cladding rehabilitation, there may remain some potentially significant unknown costs. For example, the extent of deterioration and thus the magnitude of structural repairs required cannot be determined precisely until the cladding and sheathing is removed.

MORRISON HERSHFIELD

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APPENDIX A: Tables

Table 1. Summary of Moisture Probe Survey per Building and Elevation

Moisture Content Range	Building 1				Building 2			
	North	East	South	West	North	East	South	West
30% or greater	0	0	0	0	0	0	0	0
20 to 30%	0	0	0	0	0	0	0	0
<20%	2	5	5	0	4	2	2	0
Total Probes	2	5	5	0	4	2	2	0

	Building 3				Building 4			
	North	East	South	West	North	East	South	West
30% or greater	0	0	0	0	0	0	0	0
20 to 30%	0	0	0	0	0	0	0	0
<20%	0	6	1	4	3	6	4	4
Total Probes	0	6	1	4	3	6	4	4

	Building 5				Building 6				
	North	East	South	West	North	East	South	West	TOTALS
30% or greater	0	0	0	0	0	0	1	0	1
20 to 30%	0	0	0	1	1	0	0	0	2
<20%	2	6	1	0	1	5	1	1	65
Total Probes	2	6	1	1	2	5	2	1	68

Table 2. Test Opening Inventory

Test Opening No.	Photo No.	Building and Elevation	Location	Observations
1	10,11	Building 1, south	Bulge in siding above entry door	Buckled sheathing, some white mold. OSB dry, reasonable condition
2	12	Building 1, south	Beside balcony support connection to wall	OSB dry, reasonable condition
3	13,14	Building 6, south	Intersection of concrete and wood framed walls	Wet and deteriorated gypsum sheathing and building paper
4	15	Building 6, west	At step in foundation wall	OSB dry, reasonable condition
5	16	Building 5, west	Below balcony, above patio door	OSB sheathing and balcony components dry, reasonable condition
6	17	Building 4, east	Below balcony, above patio door	OSB sheathing and balcony gypsum soffit dry, reasonable condition
7	18	Building 1, north	Flat roof/exterior wall intersection	OSB dry, reasonable condition
8	19	Building 2, north	Below 2nd floor entry landing	OSB dry, reasonable condition
9	20	Building 3, east	At step in foundation wall	OSB dry, reasonable condition
10	21,22	Building 4, south	Intersection of concrete and wood framed walls	Extensive deterioration of building paper and gypsum and OSB sheathings
11	23	Building 6, southeast	Below 3rd floor window	OSB dry, reasonable condition

Table 3. Remedial Work Recommendations Summary of Costs

DESCRIPTION	ESTIMATED UNIT COST	ESTIMATED TOTAL COST
4.1 Exterior Walls		
4.1.1 Wall Rehabilitation		
Replace existing walls with rainscreen system	$25/ft^2	To be determined
Contingency for wall framing damage	20% of wall rehabilitation cost	
Reconstruction of wall areas with confirmed deterioration (and similar locations – four such locations total)		$7,500
4.1.2 Measures to prolong life of existing walls		
Installation of proper sealant joints		$75,000
4.2 Windows, Doors, and Other Wall Penetrations		
Modification to waterproofing at windows	$700/window	To be determined
4.3 Roof Assemblies		
Install gutters and downspouts at base of gabled roofs at unit entries		$1,500
4.4 Balconies and Decks		
Install waterproofing below balcony doors	$700/door	To be determined
Install downspouts at gutters below second floor entry landings – north elevation, Building 2.		Included in 4.3 Roof Assemblies
4.5 Parking Garage and At-Grade Waterproofing		
Monitor leaks, future repairs as required		To be determined
4.6 Mold Sampling and Testing		
Possible further testing and mold remediation		To be determined
4.7 Building Maintenance		
Perform typical building envelope inspection and maintenance (general budget allowance)		To be determined
4.8 Second Stage Assessment		
Perform further investigation to better determine extent of water ingress problems and provide more accurate schedule for recommended actions.		$6,000 to $10,000

Notes:

1. These order of magnitude costs are for initial budgeting purposes only
2. For work of this nature, more accurate cost figures can only be calculated once a further investigation of the building envelope has been undertaken, and the design, specifications and detailed tender documents complete
3. The above budget costs exclude costs for unseen conditions, Engineering Fees, GST and Permit Fees.