

**ROOFING CONDITION ASSESSMENT REPORT  
QUEEN'S GATE  
8500, 8520, 8560 AND 8580 GENERAL CURRIE ROAD  
RICHMOND, BC**

Prepared for:

Strata Plan NW 3119  
c/o Vancouver Condominium Services Ltd.  
400 – 1281 West Georgia Street  
Vancouver, BC  
V6E 3J7

Attention: Mr. Peter Chan

Prepared by:

Levelton Consultants Ltd.  
#150 – 12791 Clarke Place  
Richmond, BC  
V6V 2H9

Prepared by:



Per: Tim Stubbins, A.Sc.T.  
Building Science Division

Reviewed by:



Per: David Evans, P. Eng.  
Manager, Building Science Division

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# 1. INTRODUCTION

This Roofing Condition Assessment Report pertains to the Queen's Gate residential complex located at 8500, 8520, 8560 and 8580 General Currie Road, Richmond, BC.

## 1.1. SCOPE AND PURPOSE OF REPORT

The purpose of this roof review was to provide an opinion on the current condition of the existing roofing assemblies. Only the roofing elements of this complex were reviewed by Levelton Consultants Ltd. This report is based on our visual reviews of the roofs carried out on October 1, 6 and 8, 2010. This review mainly consisted of visually identifying obvious roofing defects, spot checks of the roofing membrane below the gravel surface layer, and reviewing typical roofing details.

The purpose of this report is as follows:

- Summarize the current condition and performance of all the existing roofs (i.e., flat roof areas which include the B.U.R. membrane system the modified asphalt membrane system and sloped metal roofs including the EPDM gutter membrane) of the three (four civic addresses) buildings comprising this complex.
- Prioritize our recommendations for maintenance and remedial work.

## 1.2. DISCLAIMER

This report has been provided to the Strata for roofing condition assessment purpose only. It is not to be used or relied upon for any other reasons or by any third parties. Levelton accepts no responsibility for damages suffered by any third party as a result of decisions or actions based on this report.

It should be noted that there are some inherent limitations to this roofing assessment. First, it is difficult to detect all roofing defects below the gravel layer of the B.U.R. roof without removing all the gravel from the roof areas. As such, there is the potential for additional deficiencies on the roof areas other than those noted in this report. Another limitation of roof reviews is the quality of the roofing system. It is more difficult to assess the performance of the roofs without knowing the quality of the initial roof installation.

## 1.3. BACKGROUND INFORMATION

Four previous Roof Condition Assessment Reports have been prepared by Levelton for the Strata:

1. Approximately 17 years ago, with opinions and recommendations summarized in the Roof and Waterproofing Condition Assessment Report dated January 23, 1993.
2. The second review was completed approximately ten years ago and the findings were summarized in the Roof Condition Assessment Report dated September 21, 2000.



3. The third review was completed approximately seven years ago which the findings were summarized in the Roof Condition Assessment Report dated April 3, 2003.
4. A fourth review was completed approximately five years ago along with findings in the Roof Condition Assessment Report dated August 19, 2005.

Some of the observations from the previous assessments by Levelton Engineering Ltd. are as follows:

- Two roof areas have been replaced with 2-ply modified bitumen SBS (Styrene Butadiene Styrene) sheet membrane in 2002. The roof areas replaced are at the main entry archway roof and at building 8560, roof S7.
- There have been previous reports of "roof leaks" throughout the complex. Specific locations reported have been vague.
- The gutter drains have been restricted an/or plugged, resulting in the gutter being filled with water.
- There were some significant deficiencies at the lap seams of the EPDM gutters at the sloped metal roofs. One EPDM membrane repair utilized a self-adhered modified bitumen membrane. EPDM and modified bitumen membranes are not compatible.
- Caulking over metal flashing joints and fasteners penetrating mechanical units, etc. require replacement.
- The installation of the sloped metal roof S5A at Building 8560 is poor. Several fasteners are missing and there is an inadequate waterproofing detail at the plumbing vent.
- The roof over the entry archway as previously noted (September 21, 2000 report) contained poor details at the side of the walls. This area has been completed as part of the building envelope repairs.
- Dryer vents are to be regularly cleaned as part of ongoing maintenance. The bird screen was missing and/or misaligned. The screens are required to be installed.
- Some sloped metal roofs have been re-fastened at Building 8580.
- An SBS membrane repair at the tie-ins of the roof cant, and over the cornice was completed as part of previous building envelope remediations to the exterior walls. Construction debris and foot traffic over the roof areas were a concern.

The roof repairs recommended by Levelton Consultants Ltd. in this current report mainly consist of the following:

- Roofing repairs are required to address deficiencies which have developed, i.e. blisters, ridging, exposed asphalt, split in membrane, etc.
- Replace missing and/or misaligned bird screen at vents. Including cleaning of screens from lint build-up and extending the internal ducting to the top of the box vent.

- On the metal roofs, remove and replace all corroded fasteners and install where missing, complete with neoprene washer.
- Installation of missing neoprene closure strips at sheet metal roofs.
- Complete SBS membrane detail at roof perimeter.
- Clean debris from EPDM gutter membranes and B.U.R. roof areas.
- Remove failed caulking at sheet metal flashing joints, mechanical units, etc. and replace with new caulking.
- Remove rust on the metal roof and repaint as required.

Some of the above anomalies are indicated on the roof plans included in Appendix A to this report.

During our review on October 1, 2010; TEK roofing were on site (Roof area S1 – Building 8520) removing moss growth. TEK had indicated that they have had an ongoing contract with the Strata to conduct maintenance repairs. During our review of the roof areas, it is evident that maintenance repairs have been completed. Ongoing maintenance will be required to extend the service life of the roofs.

#### 1.4. GENERAL PROJECT DESCRIPTION

Queen's Gate is an existing residential development, which was constructed in 3 phases. The following summarizes the description of the complex:

<b>Number of Buildings:</b>	Phase 1 (South Buildings 8520 and 8560)
	Phase 2 (West Building 8500)
	Phase 3 (East Building 8580)
<b>Construction Type:</b>	Combustible (wood frame)
<b>No. of Storeys:</b>	3-storeys
<b>Type of Roofing System:</b>	Built-Up Roofing System (B.U.R.)
	Sloped Metal Roofs
	Single-ply EPDM roofing membrane (Mainly at sloped metal roof gutters)
	Two-Ply (SBS) modified asphalt sheet membrane systems installed in 2002 at the main entrance archway and Building 8560 Roof S7.

<b>Age of Building:</b>	South Building: 20 years (completed in 1990).
	West Building: 19 years (completed in 1991).
	East Building 18 years (completed in 1992).
<b>Reports of Leaks:</b>	One leak reported. Water stained ceiling in the hallway outside units 318 & 319 below Roof Area S3 at Building 8520.
<b>Pervious Roof Repairs:</b>	Repairs consisted of anomalies in the B.U.R. assembly being patched with SBS membrane, replacement of PVC vent caps, painting of corroded vent hoods, filling gum pans, wrapping electrical cables with EPDM membrane, etc.

## 2. DESCRIPTION OF ROOF SYSTEMS

### 2.1. BUILT-UP ROOF (B.U.R.) ASSEMBLY

#### Roof Elements

The roofs have been waterproofed with built-up roofing (B.U.R.) membrane. This is probably one of the oldest roofing systems available. It has been used for over 100 years in North America. It typically consists of 3 to 4 plies of organic felts laid in hot applied asphalt. The top layer of asphalt is usually covered with granular material to protect it from ultra-violet radiation. This type of roofing membrane typically has a lifespan of 15 to 20 years with proper maintenance.

Based on the Levelton Engineering Ltd. report dated January 22, 1993, the B.U.R. roof assembly consists of the following elements:

- 5 ply Built-up asphalt and gravel assembly  
(Two-ply modified sheet membrane used as a replacement membrane)
- 5/8" T & G plywood sheathing
- slope shims
- 2'x4 " sleepers at 24" centers for cross ventilation
- vented attic spaces
- roof joists as per structural plans
- R28 batt insulation
- 2 mil poly vapor barrier

- gypsum wallboard ceiling finish

It should be noted that a cut test at Phase 2 at the time of the first review revealed that the 5-ply built-up roof specified on the drawings actually consisted of the two layers of loose laid organic felts on plywood sheathing with three layers of organic felts mopped on with hot asphalt. A flood coat of asphalt and gravel was then applied to the top of the roof. As such, this roof system should be considered as a 3-ply built-up roofing system.

The roofing felts and asphalt from the B.U.R. membrane perform as the waterproofing membrane to provide protection against moisture penetration. The gravel protects the B.U.R. membrane from ultra-violet exposure.

The main B.U.R. roof areas of all three phases are divided into smaller roof areas by firewalls, which limit the expansion and contraction of the roof system. For the purpose of this report, these smaller roof areas are individually identified on the reduced roof plans included in Appendix A to this report.

Note: The above assembly and description was not reconfirmed for this current report. We have assumed for this report that the same as-built components and assembly still exists

### **Roof Drainage**

The B.U.R. roof areas are typically sloped to one or two sumped roof drains and internal drainpipes to shed water collecting on the roof areas. Smaller rectangular BUR roofs over elevators shafts, etc. which extend above the main B.U.R. roofs, are provided with drain scuppers and downspouts that discharge water onto concrete splash pads on to the lower B.U.R. roofs.

The perimeter of the roof areas are provided with curbs that are capped with metal flashing. Decorative metal cornices are provided below the roof curbs.

Some smaller roofs over bay window sections, etc. were not accessed. However, a visual review from an adjacent roof area allowed a cursory review of these areas to be performed.

### **Roof Penetrations**

The flat roof areas are penetrated by numerous penetrations such as exhaust and dryer vents, plumbing vent pipes, skylights, lead pipes for electrical and gas lines, and gas fireplace chimneys.

Air conditioning units are supported on curbs which are located on top of the roof areas.

Sloped metal roof dormers are located around the outside perimeter of the flat roof areas. Water runs off the metal roofs into gutters which discharge water through downpipes onto concrete splash pads resting on the B.U.R.

## **2.2. SLOPED METAL ROOFS**

Based on the Levelton Engineering Ltd. report dated January 22, 1993, the sloped metal roofs of all three phases consist of the following elements:

- Pre-finished metal roof “cladding”,
- Building paper,
- ½ “ plywood sheathing with H clips,
- rafters or trusses as per structural drawings.

The ½” plywood sheathing was substituted with wood strapping during the construction stage of the project.

The sloped roofs over architectural dormers are comprised of ribbed metal panels set on wood strapping, which are mechanically fastened with a combination screw and neoprene gaskets which provides a waterproof seal. Some fastener heads are caulked with sealant or covered with plastic caps. The ceiling of the top storey is located below the sloped roof. The attic spaces below the sloped roofs are provided with insulation and are vented to the exterior by square metal grilles within the stucco clad exterior gable walls.

Generally, most of the sloped metal roofs are gable type roofs. However, some sloped roofs incorporate hips and valleys.

The sloped roofs use an EPDM (Ethylene Propylene Diene Monomers – synthetic rubber) gutter system at the base/eave of the sloped roofs. The gutters collect and drain the water from the sloped roofs onto concrete splash guard on the lower BUR roof via scuppers and downspouts.

The metal roof incorporates decorative metal cornices adjacent to the EPDM gutter and outside face of the dormers.

The use of ridge cap flashing at the peak of the sloped roof and back-lapped flashing are typical throughout the complex. In some cases, neoprene closure strips have been installed under the ridge cap to prevent wind driven rain from entering.

The edges of the metal roofs generally do not extend beyond the face of stucco walls. At some locations, additional metal drip flashings have been provided to protect the stucco walls.

The sloped metal roofs are typically penetrated by stucco clad chimneys, which extend above the metal panels.

The above comments are generally a repeat of the opinions and observations from previous reports and are still valid. This cursory review did not include removal of roof components to verify the above or if any changes have occurred.

## 2.3. ROOF OVER ENTRY ARCHWAY

This roof area is located between the Phase 1 and 2 buildings on the north side of the complex. The roofing system consist of a two-ply modified bitumen (Styrene Butadiene Styrene) roofing membrane with two internal roof drains at either end of the roof area that was re-roofed in 2002. This roof area was not accessed directly and was reviewed from the adjacent building roof surfaces.

## **2.4. BUR ROOFING DEFICIENCIES**

For the purpose of this report, the following summarizes some of the typical roofing defects that were observed on the B.U.R. roofs of this complex. Their name, description, possible causes and effects of these defects are noted.

### **Surface Blisters**

Small 'clumps' (bubbles) of asphalt migrating up through the gravel surface coating of the roofing, caused by heat. (Photo 7) If these bubbles break, small craters are formed and the thickness of the asphalt is reduced, which may eventually expose the underlying felts to the weather.

### **Structural Blisters**

Air bubbles, which expand between plies of felt or between the membrane and substrate (plywood) caused by trapped air or air and moisture. As the blister expands, the gravel surfacing may "fall away" exposing the asphalt. Exposed asphalt may result in membrane failure (tear or open up laps and fishmouths).

### **Ridging**

Narrow ripples in membrane caused by movement of either the felts or substrate under moisture or thermal effects. (Photo 25)

As the ridge continues to rise upwards, the asphalt top coating and the felts are exposed to the weather, resulting in premature deterioration of the membrane. The split in the roofing membrane will be exposed to water penetration.

### **Ponding of Water**

Ponding is defined as water in low or irregular roof areas that remains longer than 48 hours after rainfall.

Caused by an indentation in the roof areas or inadequate roof drainage, ponded water can enter the roofing membrane through any membrane imperfections. Water can also accelerate the degradation of the B.U.R. membrane, and also promote vegetation and fungi growth.

### **Alligator Cracking**

Hardening and shrinking of exposed asphalt on the surface of the built-up roof. The cracking pattern resembles an alligator's hide. As the cracks harden and deepen, the roofing felt will be exposed to the weather causing deterioration of the roofing felt (rot, blisters and cracks).

### **Bare Spots**

Surface areas of the built-up roof are inadequately protected with sufficient gravel, exposing the asphalt to the weather.

Premature deterioration (cracking and blistering) of the exposed asphalt will occur.

## Exposed Felt Edges

Curling of felt edges due to poor initial installation. Edges of the felt can wick moisture into the roofing membrane when it is covered with moisture.

## Moss Growth

Vegetation/moss growth will retain moisture which can accelerate the degradation of the B.U.R. roof assemblies.

# 3. BUR ROOFING SYSTEM

## 3.1. EXISTING CONDITION / DEFICIENCIES

For the purpose of identifying and prioritizing remedial repairs, the BUR roofs of this complex have been categorized as follows:

**South Building 8520 and 8560:** Roof No. S1 to S6

**West Building 8500:** Roof No. W1 to W5

**East Building 8585:** Roof No. E1 to E5

The perimeter areas of several roof areas on all three (four civic addresses) buildings have been remediate as part of the building envelope remedial repairs. The portion of B.U.R. removed (debris) has been left on the roof surface. (Photo 19)

Based on our visual reviews, the following summarizes some of the deficiencies that were observed on the above roofs:

Generally, all the roof areas except the two re-roofed in 2002 exhibited varying degrees of the roofing defects noted in Section 2.4 of this report.

- There have been SBS repairs around the roof perimeter parapet curb, although not all areas have been addressed. The protection course has degraded exposing the asphalt to U.V (Photo 32).
- It appears that some repairs around lead stacks were completed that ran electrical cable to the roof top mechanical units. The repair included the use of gum/pitch pans which are not recommended by the Roofing Contractors Association of BC. The 'mastic' used to seal/fill the gum pan has been reapplied as part of the ongoing maintenance.
- Exposed felt edges, ridges (Photo 25), and surface blisters (Photo 22) were noted throughout roof areas. The exposed felt edges appear to occur at the 1<sup>st</sup> felt layer and are no longer protected by the surface gravel. If not repaired, the exposed felt will continue to deteriorate (crack, blister) through the remaining 2 plies.

- Sealing compound was used around a lead vent stack (Photo 11) to prevent further water ingress as a result of a leak in Building 8520.
- Split (or crack) in the membrane has developed (Photo 27). If left, the crack could further open up creating a point of water ingress.
- Moss growth will be an ongoing maintenance item. Most roof areas exhibit moss over the B.U.R. membrane (Photo 16).
- Alligator cracking was observed at the base of flashing at firewalls, stucco walls of slopped roof, skylights, roof vents, etc., due to exposed bitumen (bare spots) (Photo 12) to ultra-violet light. These locations should be covered with modified bitumen (SBS) strips, which will protect the underlying felts from ultra-violet exposure.
- Dark dirt staining on the BUR were observed indicating potential water ponding problems. There was significant rain during the month of September, 2010. Ponding was observed on the Archway Roof and South Building 8520, Roof Area S1.
- Waterproofing membrane was not installed underneath the perimeter curb flashing. The condition is being repaired as part of the ongoing building envelope repairs to the exterior walls. Most perimeter areas have been rectified, although debris (clumps at asphalt) has been left on the roof (Photo 19).
- Some galvanized vent boxes were submerged in water, and are now corroding at the base of the flashing. Some of the exposed bitumen around the base of the vent has cracked due to U.V. exposure (Photo 38 and 40).
- Some lead pipes were too low on the BUR roof. Snow and/or water build-up on the roof may enter the short lead pipes. A hole was observed in one pipe (Photo 31).
- The PVC vent caps used are deteriorating (Photo 2). Some of the vent caps have been replaced as part of ongoing maintenance (see Photo 31).
- Splash pads were missing (Photo 30) or deteriorated (Photo 13) at some locations. This condition can wash away gravel, exposing the unprotected bitumen.
- Sealant was used to seal the flashing joints to prevent water penetration. The use of sealants to manage moisture penetration is not a recommended long term situation. Acknowledging that this is inherent in the design of the metal flashing, frequent maintenance is required to ensure the sealant has not failed. A small crack or hole in the sealant may allow water ingress. Sealant is deteriorating due to ultra-violet exposure. Sealant used around storm collars (Photo 37) will be an ongoing maintenance requirement.
- Plastic strainers over the roof drains were not firmly secured, which can be easily displaced by wind. The strainers have been "weighted" down by concrete (portions of concrete paver) (Photo 14).
- At a number of drain sumps, there was exposed bitumen and cracking at the edges and the corners (Photo 18). The exposed bitumen is inadequately protected by the surface gravel. Some existing BUR drain sumps have been repaired using modified bitumen SBS membranes. Since the water can pond at the drains, any defects

around the drain sumps should be repaired. Blisters and open membrane laps were observed at some repaired sump drain areas.

- Rusting/corrosion were observed on the galvanized metal vents penetrating the roof assembly (Photo 33), mechanical units (Photo 47), chimney cap flashings (Photo 46) and metal cap flashings over the firewalls (Photo 42) and perimeter parapet curb. Several vent caps have been painted to help minimize and/or deter corrosion.
- SBS repairs have been made throughout. The roof access hatch curb on Building 8500 was repaired with an SBS membrane. Damage has occurred at one corner (Photo 24), exposing the bitumen.
- Bird screen at the dryer vents were clogged with lint (Photo 2). Lint build-up can prevent moisture laden air from discharging causing moisture to migrate internally. Lint build-up can also create a fire risk. Further, the ducting at several vents was observed to be too low (Photo 3), missing or incomplete bird/insect screen (Photo 34), and one duct was observed to be off set to the vent box at Roof Area E4 (adjacent to the roof access hatch), which will restrict air flow.

### 3.2. RECOMMENDATIONS

In order for the BUR roofing to properly perform during its service life, Levelton recommends the following:

- the roofing material must be properly designed and installed in accordance with good roofing practices;
- the roofing membrane (felt layers and bitumen) must be protected from weather (e.g. water and ultra-violet light);
- water must be shed from the roof areas as quickly as possible; and,
- the BUR must be properly maintained during the service life of the roof.

Ongoing maintenance is required. Such items to maintain are:

- Resealing caulking at the metal cap flashing joints, storm collars, etc.
- Resealing caulking at the electrical and gas lines for the roof top mechanical units.
- Cleaning of dryer ducts. Install and/or correct bird screens. Extend ducting to the top of the vent boxes.

With the ongoing maintenance, the existing BUR roof is in relatively fair condition with the exception of a few roof areas noted below as high priority. It is our opinion that the existing deficiencies on the roofs can be repaired to prolong the service life of the roof. The high priority roof areas should be considered to be replaced within 1 to 2 years. Replacement of the remaining roof areas should be considered in approximately 2 to 3 years. Our recommendations for remedial work are as follows:

- Roofing defects identified during our visual review and noted on the reduced floor plans should be repaired. The specific type of roof repair will be confirmed based on discussions with a roofing contractor. These repairs are intended to limit further deterioration of the roofing membrane.
- The roof areas showing water ponding are of concern, since there is the potential that standing water may enter the roofing system through defects in the roofing membrane. As such, at these areas of the roof, gravel should be removed and any defects found beneath the gravel should be repaired.
- When the roof is eventually replaced, roof crickets (tapered insulation) should also be installed to improve the roof slope. The extent of the roof areas showing potential water ponding is identified on the reduced floor plans included in Appendix A of this report.

#### Priority of Roof Remedial Work:

##### **South Building 8520 and 8560:**

High Priority – Roof S3  
Medium Priority – Roofs S2

Low Priority – Roofs S1, S4, S5, and S6

##### **West Building 8500:**

High Priority – Roof W5

Low Priority – Roofs W1 to W4

##### **East Building 8585:**

High Priority – Roof E1

Medium Priority – Roof E2

Low Priority – Roofs E3 to E5

## **4. SBS ROOFING SYSTEM**

### **4.1. EXISTING CONDITION / DEFICIENCIES**

For the purpose of identifying and prioritizing remedial repairs, SBS roofs of this complex have been categorized as follows:

#### **South Building 8560 Roof Area S7**

##### **Archway/Entrance Roof Area**

The two-ply SBS (Styrene Butadiene Styrene) modified asphalt sheet membrane system are generally in good condition. Our observations are as follows:

- On Roof Area S7, minor wrinkles (Photo 48) have formed in the membrane. It is unclear at this time to what caused the wrinkles.

- Ponding water (Photo 35) and/or signs of ponding water were observed over both roof areas.
- An excessive number of screws (Photo 9) have been fastened through the cap flashing.
- Debris build-up observed around the drains will restrict water flow.
- Base of stucco wall at Roof Area S7A was not finished (Photo 10) at the time the roof was replaced.

## 4.2. RECOMMENDATIONS

- Monitor the wrinkles in the membrane.
- Remove debris from the roof surface/drains.
- Repair base of stucco wall at Roof Area S7A.
- At the cap flashings, remove the fasteners, remove the metal cap flashing, repair the membrane and replace with new metal cap flashing.

## 5. SLOPED METAL ROOFS

### 5.1. EXISTING CONDITION / DEFICIENCIES

For the purpose of identifying and prioritizing remedial repairs, the sloped metal roofs of this complex have been categorized as follows:

<b>South Building 8520and 8560:</b>	Sloped Roof No. S1A to S7A
<b>West Building 8500:</b>	Sloped Roof No. W1A-C to W5A
<b>East Building:</b>	Sloped Roof No. E1A-C E5A-C

The following summarizes the existing condition and priority of sloped metal roof areas located around the roof perimeter of each building.. Note that some of the sloped roofs have been repaired, as described in Section 1.3 of this report. Generally, the metal roofs are in poor condition, relying on sealant to manage moisture penetration.

- At some gutter locations, the seals in the EPDM appear to be repaired with sealant, which is now failing (Photo 20). It is our understanding that this deficiency was a previous source of water ingress into the building. In addition, the EPDM does not extend to the outside face of the gutter nor adequately up the sloped roof.
- Back-sloped flashing and sealant was used at the corners of the sloped roof. When the sealant fails, water can enter the roof at the back-sloped joint.

- The typical fasteners attaching the metal roof to the underlying wood strapping were deficient throughout the metal roofs. Fastening at the base of the metal roofs is deficient. The location of the fasteners at the base can be critical to preventing wind uplift (Photo 23). Some fasteners were missing, not fully fastened down to the metal sheet (Photo 44), corroding, not provided with protective plastic caps, and/or fastened at an angle.
- EPDM membrane repairs have been carried out, which included:
- Self-adhered modified bitumen membrane applied over the EPDM. However, the two types of membrane are not compatible.
- There was debris in some of the EPDM gutters (Photo 17), which can inhibit the flow of water into the downspouts. Ponding water was observed in a few gutters because the drains are restricted or plugged (Photo 28).
- Tenting is a common problem with EPDM gutters. Tenting (Photo 36) is a result of the membrane "shrinking" resulting in the membrane to be unsecured.
- Some cap flashing over the firewalls of the sloped roofs are not fitted together (Photo 43), which could allow water ingress between the flashing joints.
- Membrane installed under the metal cap flashing is exposed and deteriorating due to U.V. exposure (Photo 45).
- Scuffing/scratches on the metal roof showing corrosion was visible throughout the metal roofs (Photo 5, 44, 45).
- Some splash pads were missing.
- Neoprene closure strips are not continuous (Photo 21), degrading due to U.V. exposure and are missing at the top of roof panels below the ridge/hip caps.
- The metal roofs on the four buildings do not extend beyond the face of the stucco walls. As such, the stucco walls are not protected and are exposed to water flowing down the wall from the sloped roof (Photo 15). Numerous cracks on the stucco wall have been sealed with caulking (Photo 1).
- The metal roofs are painted. The paint is oxidizing.
- The soffit section under the sloped metal roof was not properly secured (Photo 26). The opening could be a point of entry for insect migration.

Sources of potential water ingress that can enter below the metal roof are suspected at the following locations:

- hardened and cracked neoprene fastener gaskets;
- the failed joint between the 2-piece ridge cap flashing;
- failing joints and seams in the EPDM gutters;

- clogged drains in EPDM gutters;

## 5.2. RECOMMENDATIONS

The following remedial measures should be implemented for the sloped metal roofs of this complex:

- Remove and replace all corroded fasteners and install where missing, complete with new neoprene washers.
- Repair and repaint all scratch marks and corrosion on the metal roofs.
- Clean, wash and remove all debris at all gutters.
- Review and maintain a waterproof seal between the two piece ridge caps flashing.
- Review all joints in the metal roof sealed with caulking and replace failing sealant as required. Some joints may be required to be re-connected.
- Provide splash pads where missing.
- Ensure all gutter drains are functional.
- Install/replace missing neoprene closure strips.
- Reseal loose membrane at copper scupper drains.

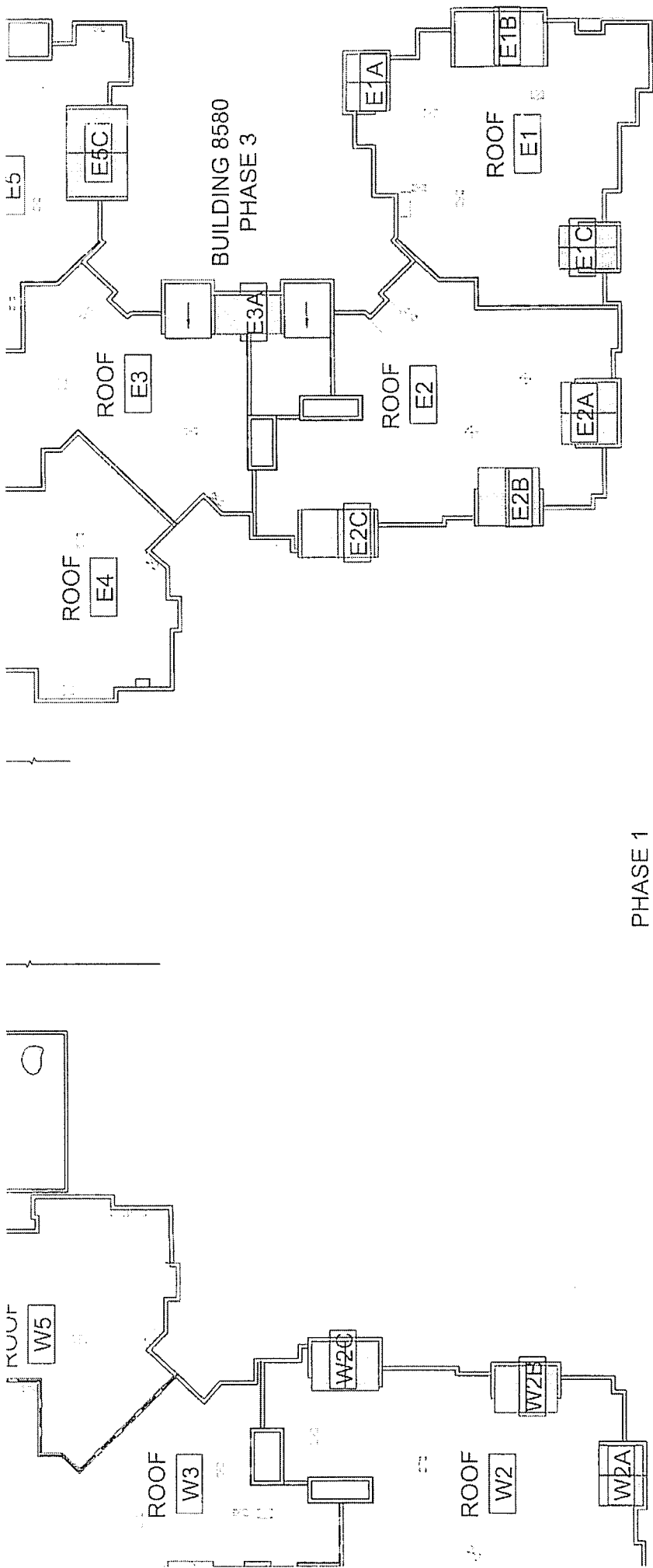
Based on the condition of the roof, it is our opinion that total replacement of the existing metal roof is recommended. We recommend that the EPDM gutter membrane be replaced at the same time. There have been no reports of leaks through failed fasteners in the field of the metal roof. As previously noted in past reports, some of the existing sloped roofs have been repaired. Accordingly, we are recommending that high priority roofs be completed first. The remaining sloped roof can be replaced in a phased approach.

### Priority of Roof Remedial Work

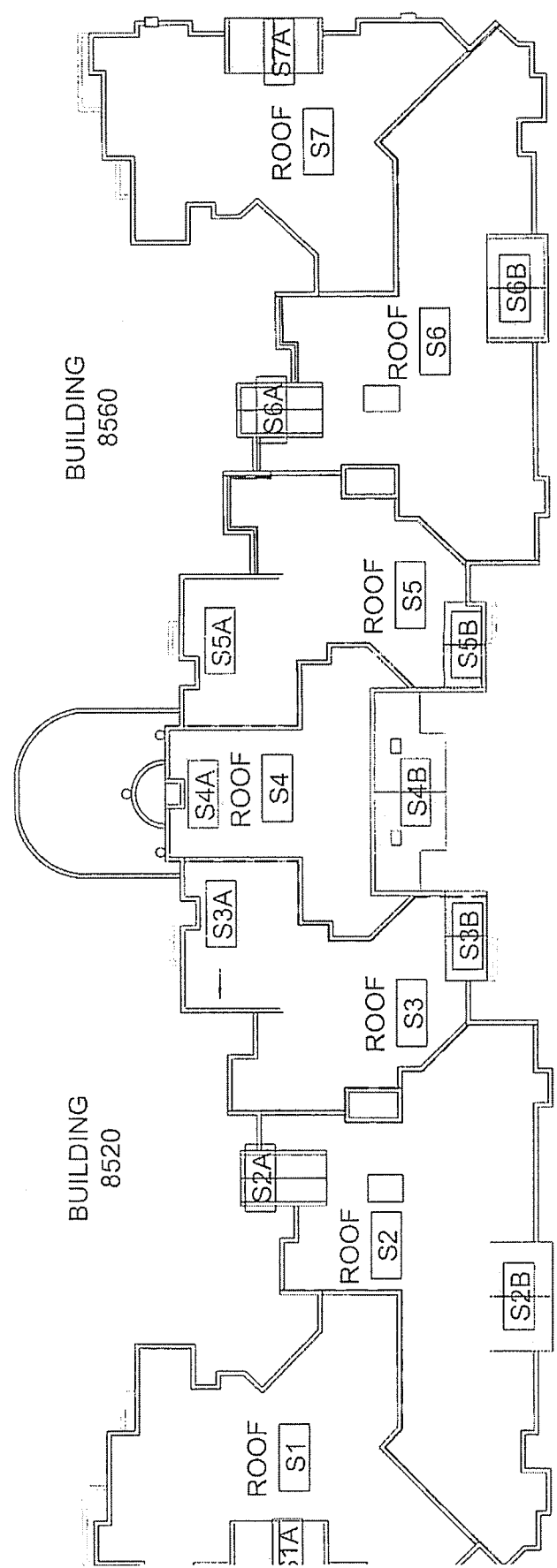
<b>South Building 8520 and 8560:</b>	High Priority – Roofs S5A and S4B
	Medium Priority – Roofs S1A to S7A
<b>West Building 8500:</b>	High Priority – Roof W1A
	Medium Priority – Roofs W1B-C to W5A
<b>East Building 8580:</b>	Medium Priority – Roofs E1A-C to E5A-C

# **Appendix A**

## **REDUCED ROOF PLANS**



PHASE 1



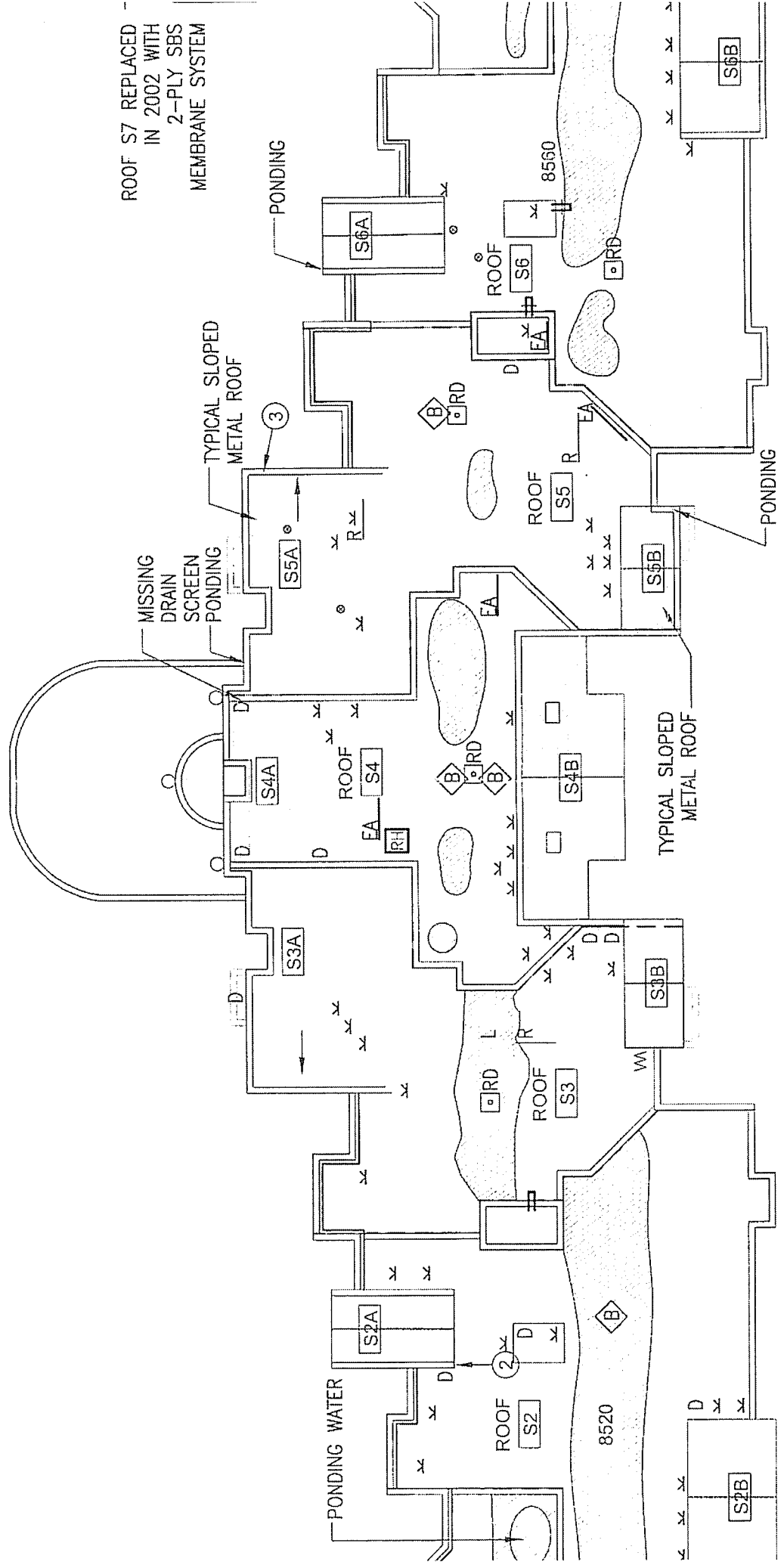
BUILDING 8520

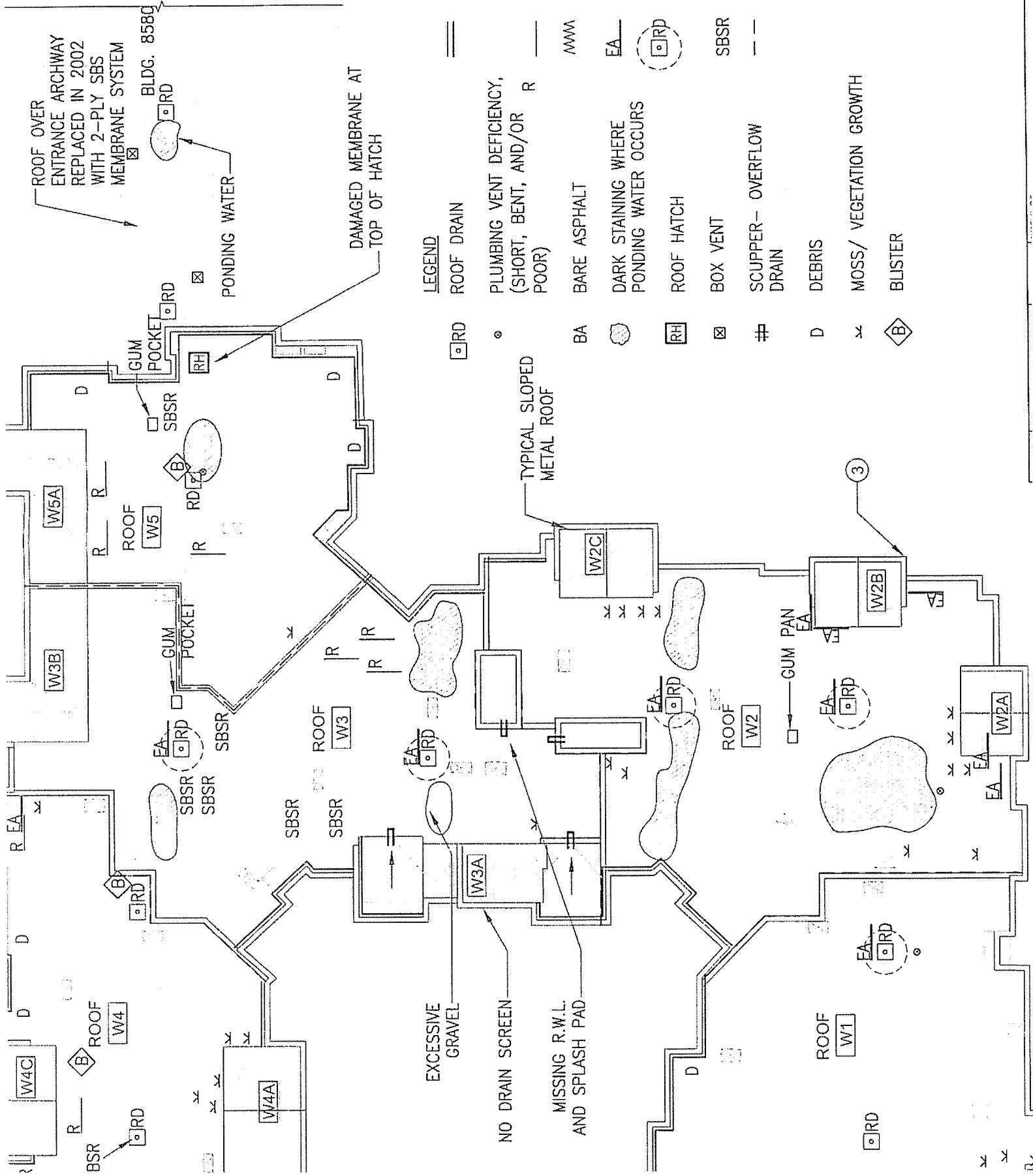
- (2) LOOSE MEMBRANE AT GUTTER DRAIN
- (3) FASTENER INSTALLED THROUGH METAL CAP FLASHING

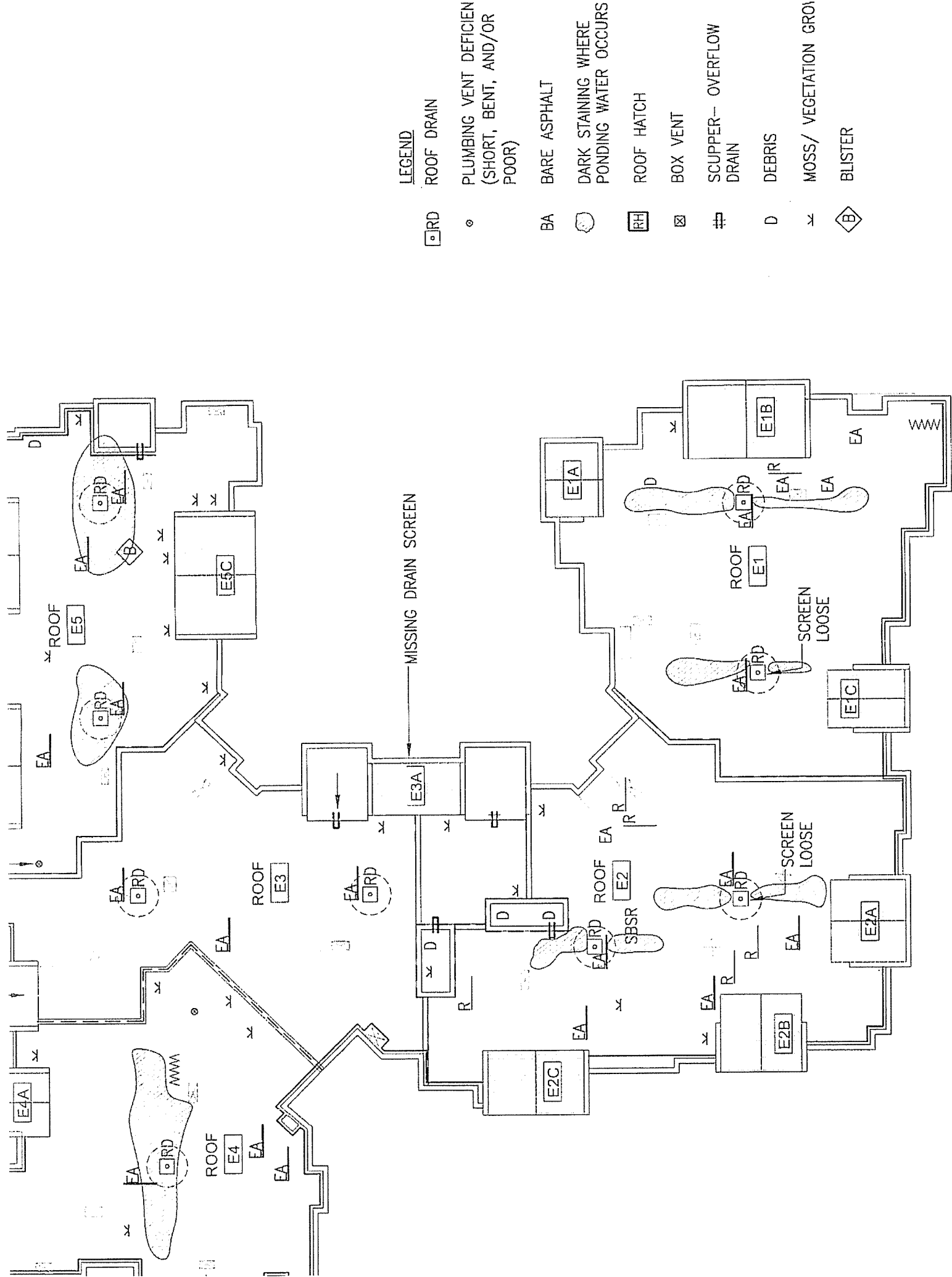
R — RIDGE  
 ^^^ EXPOSED FELT EDGES  
 EA — EXPOSED ASPHALT EDGES  
 - - - FIREWALL

**E1B** LOCATION OF BUILDING (EAST,  
WEST, OR SOUTH)  
SECTION OF FLAT ROOF,  
SECTION OF SLOPED METAL ROOF

ROOF S7 REPLACED  
IN 2002 WITH  
2-PLY SBS  
MEMBRANE SYSTEM





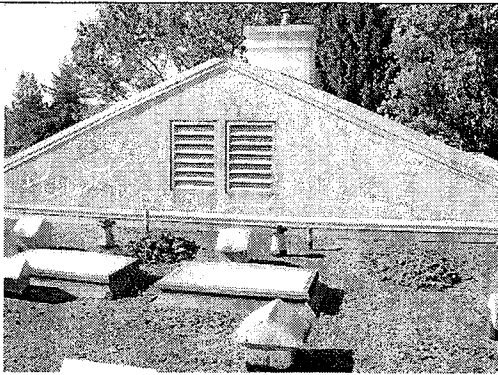

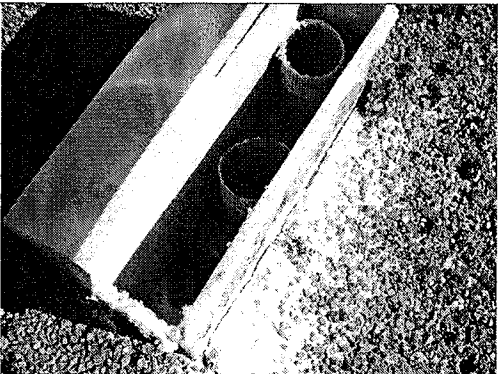
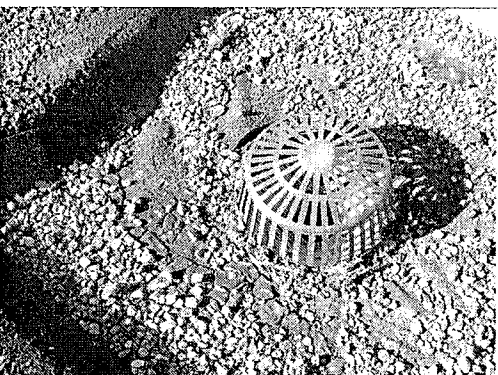


- LEGEND**
- RD ROOF DRAIN
  - PLUMBING VENT DEFICIENT (SHORT, BENT, AND/OR POOR)
  - BA BARE ASPHALT
  - ☉ DARK STAINING WHERE PONDING WATER OCCURS
  - ⌘ RH ROOF HATCH
  - ⊠ BV BOX VENT
  - ⌘ SCUPPER-- OVERFLOW DRAIN
  - D DEBRIS
  - ⋈ MOSS/ VEGETATION GROWTH
  - ◇ BLISTER

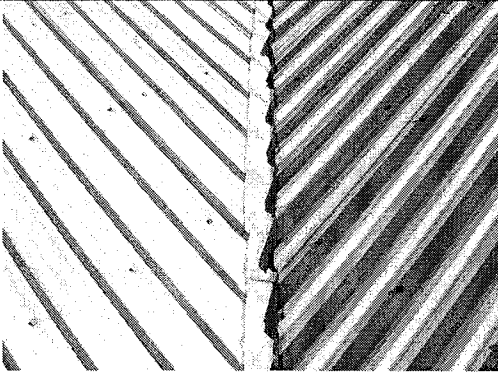
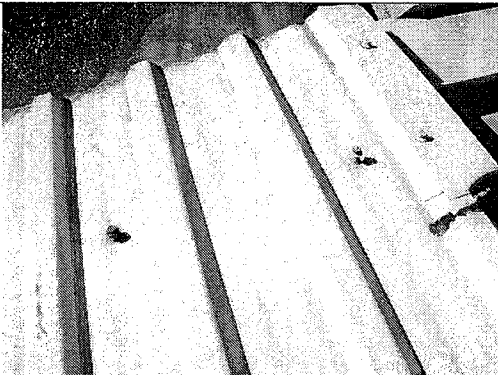

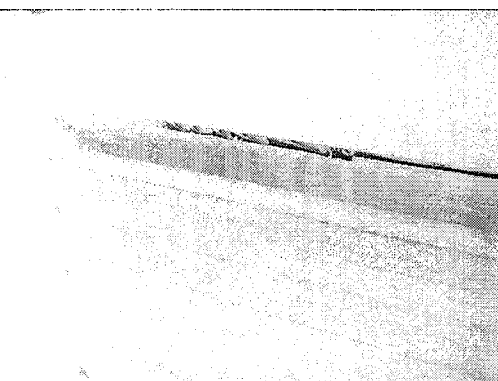
## **Appendix B**

### **PHOTOGRAPHS**

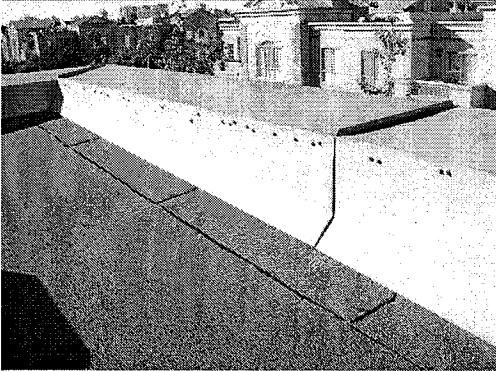

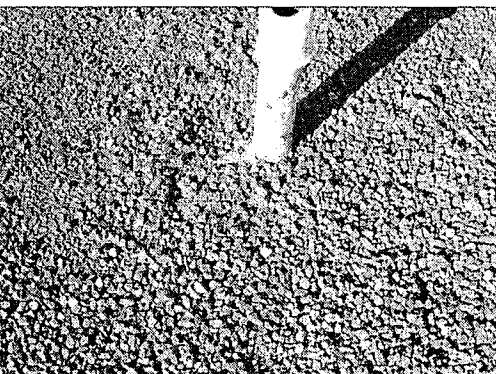
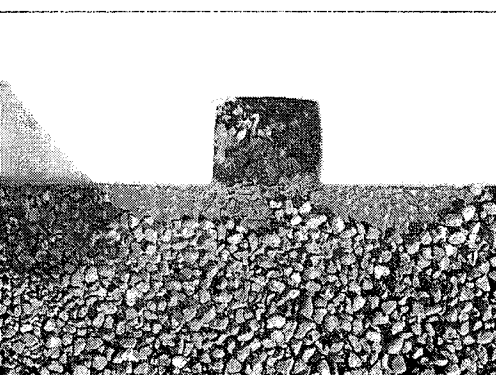
## PHOTOGRAPHS

1		<p><b>Building 8520 Roof Area S1A</b></p> <ul style="list-style-type: none"> <li>Cracks in stucco wall sealed with caulking as part of ongoing maintenance.</li> </ul>
2		<p><b>Building 8520 Roof Area S1</b></p> <ul style="list-style-type: none"> <li>Lint from dryer duct collecting on the roof.</li> </ul>
3		<p><b>Building 8520 Roof Area S1</b></p> <ul style="list-style-type: none"> <li>Metal cap over dryer duct not secured.</li> <li>Missing insect screen.</li> <li>Exhaust ducts should extend to top of vent.</li> </ul>
4		<p><b>Building 8520 Roof Area S3</b></p> <ul style="list-style-type: none"> <li>Open lap edge.</li> </ul>


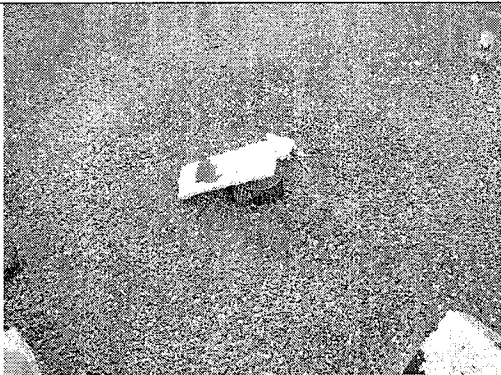
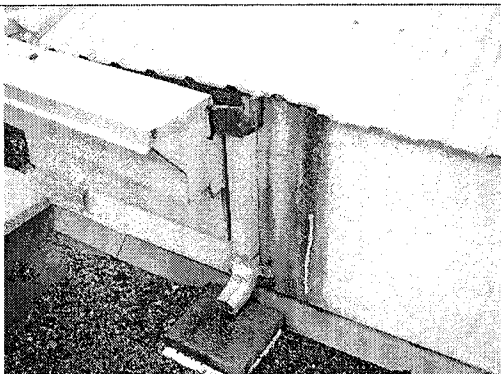
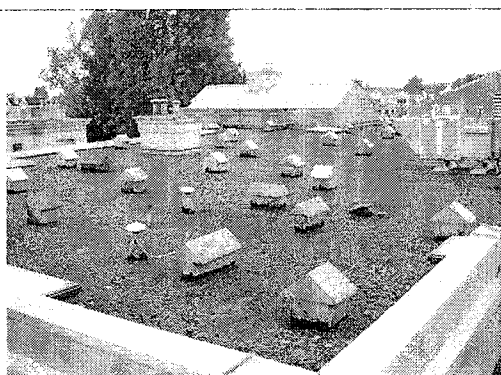
## PHOTOGRAPHS

5		<p><b>Building 8520 Roof Area S4A</b></p> <ul style="list-style-type: none"> <li>• Scratches in paint coating</li> <li>• Corrosion forming on bare metal.</li> </ul>
6		<p><b>Building 8560 Roof Area S4A</b></p> <ul style="list-style-type: none"> <li>• Fasteners “popping” up.</li> </ul>
7		<p><b>Building 8560 Roof Area S6</b></p> <ul style="list-style-type: none"> <li>• Exposed asphalt – clumps of asphalt forming through gravel protection exposed to ultraviolet light.</li> </ul>
8		<p><b>Building 8560 Roof Area S4B</b></p> <ul style="list-style-type: none"> <li>• Exposed membrane below stucco chimney chase.</li> </ul>

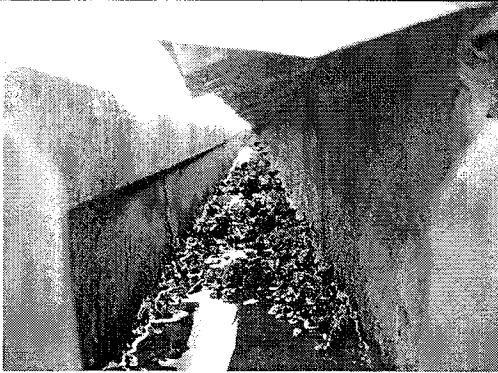

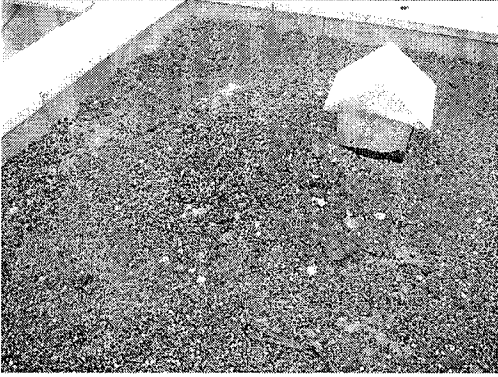
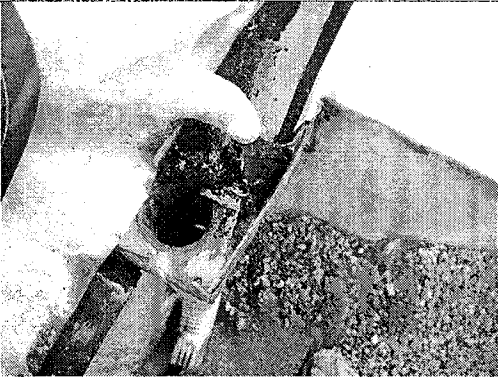
## PHOTOGRAPHS

9		<p><b>Building 8560</b> <b>Roof Area S7</b></p> <ul style="list-style-type: none"> <li>• Several fasteners installed through metal cap flashing.</li> </ul>
10		<p><b>Building 8560</b> <b>Roof Area S7A</b></p> <ul style="list-style-type: none"> <li>• Base of stucco wall was left unfinished.</li> </ul>
11		<p><b>Building 8520</b> <b>Roof Area S3</b></p> <ul style="list-style-type: none"> <li>• "Sealing" compound used to stop leak in roof system.</li> </ul>
12		<p><b>Building 8560</b> <b>Roof Area S6</b></p> <ul style="list-style-type: none"> <li>• Exposed asphalt at drain scupper is U.V. damaged.</li> </ul>

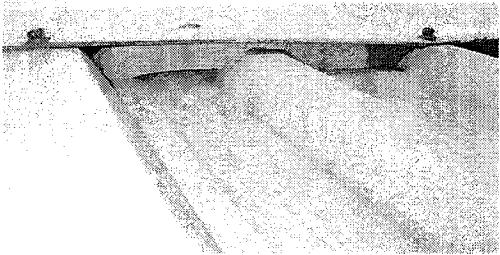
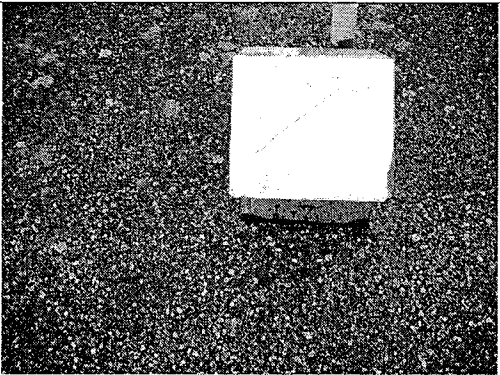

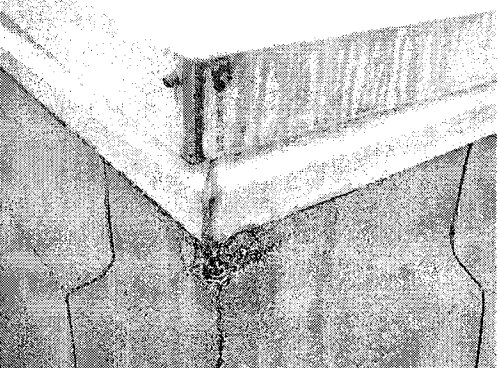
## PHOTOGRAPHS

13		<p><b>Building 8560</b> <b>Roof Area S6</b></p> <ul style="list-style-type: none"> <li>Deteriorated concrete splash pad.</li> </ul>
14		<p><b>Building 8500</b> <b>Roof Area W1</b></p> <ul style="list-style-type: none"> <li>Concrete used to "secure" drain guards.</li> </ul>
15		<p><b>Building 8500</b> <b>Roof Area W1A</b></p> <ul style="list-style-type: none"> <li>Metal roof panels do not extend long enough causing staining on stucco wall from water run off.</li> </ul>
16		<p><b>Building 8500</b> <b>Roof Area W1</b></p> <ul style="list-style-type: none"> <li>General view of roof area.</li> <li>Some moss growth occurring.</li> </ul>

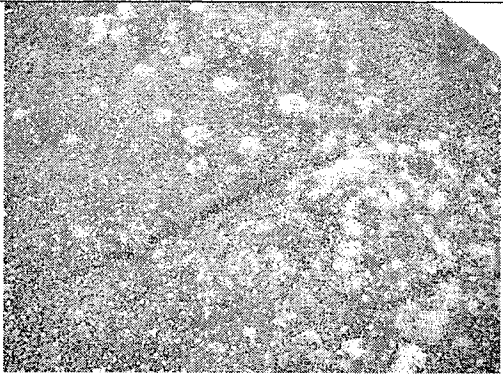

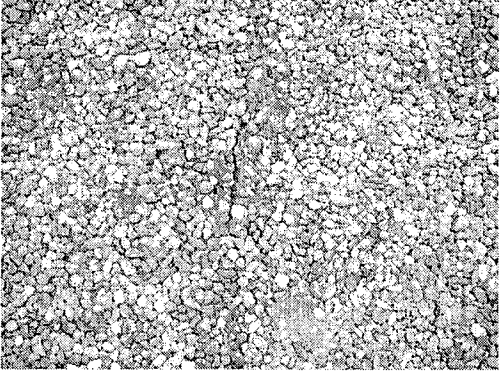
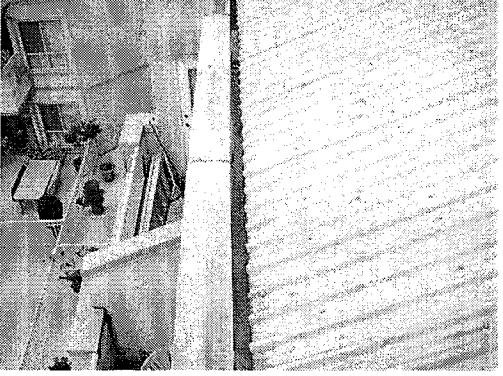
## PHOTOGRAPHS

17		<p><b>Building 8500 Roof Area W2C</b></p> <ul style="list-style-type: none"> <li>• Debris in gutter.</li> </ul>
18		<p><b>Building 8500 Roof Area W2</b></p> <ul style="list-style-type: none"> <li>• Exposed asphalt around perimeter of sump drain.</li> </ul>
19		<p><b>Building 8500 Roof Area W1</b></p> <ul style="list-style-type: none"> <li>• Debris from roof repairs left on roof.</li> </ul>
20		<p><b>Building 8500 Roof Area W1A</b></p> <ul style="list-style-type: none"> <li>• EPDM membrane not bonded at drain scupper.</li> </ul>

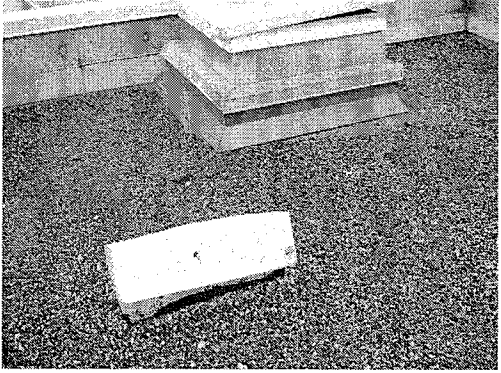
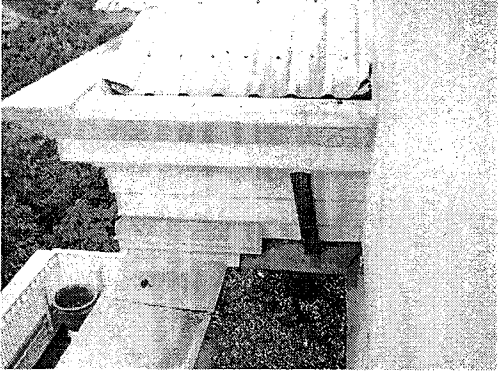


## PHOTOGRAPHS

21		<p><b>Building 8500 Roof Area E1C</b></p> <ul style="list-style-type: none"> <li>• Foam closure strip at top of metal roof (under ridge cap) is not continuous.</li> <li>• U.V. damaged.</li> </ul>
22		<p><b>Building 8580 Roof Area E5</b></p> <ul style="list-style-type: none"> <li>• Blister forming next to the vent.</li> </ul>
23		<p><b>Building 8500 Roof Area W4B</b></p> <ul style="list-style-type: none"> <li>• Fasteners were installed too high above the bottom of metal roof panels.</li> </ul>
24		<p><b>Building 8500 Roof Area W5</b></p> <ul style="list-style-type: none"> <li>• Damaged membrane at corners of roof access hatch.</li> </ul>



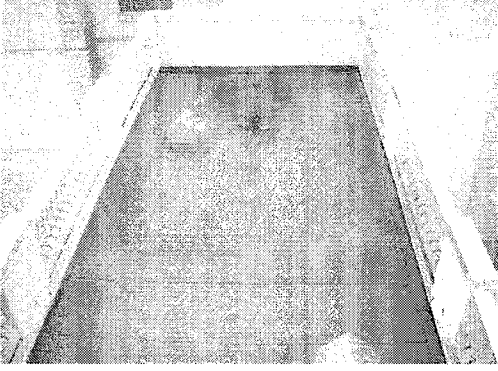
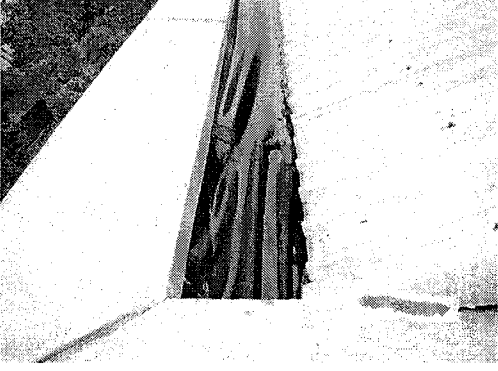
## PHOTOGRAPHS

25		<p><b>Building 8500 Roof Area W4</b></p> <ul style="list-style-type: none"> <li>• Ridge forming in BUR membrane.</li> </ul>
26		<p><b>Building 8580 Roof Area E5</b></p> <ul style="list-style-type: none"> <li>• Soffit not secured.</li> </ul>
27		<p><b>Building 8580 Roof Area E5</b></p> <ul style="list-style-type: none"> <li>• Split in membrane.</li> </ul>
28		<p><b>Building 8500 Roof Area W3A</b></p> <ul style="list-style-type: none"> <li>• Ponding water in gutter.</li> <li>• Drain restricted.</li> </ul>

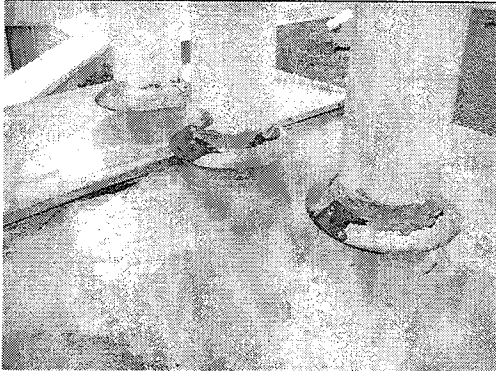
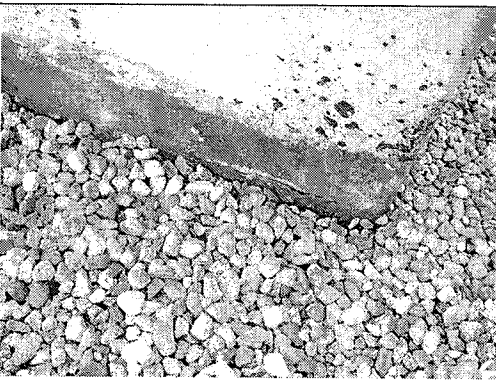


## PHOTOGRAPHS

29		<p><b>Building 8580 Roof Area E4</b></p> <ul style="list-style-type: none"> <li>• Top of vent cap not properly secured.</li> </ul>
30		<p><b>Building 8580 Roof Area E5</b></p> <ul style="list-style-type: none"> <li>• Missing splash pad.</li> </ul>
31		<p><b>Building 8580 Roof Area E5</b></p> <ul style="list-style-type: none"> <li>• Hole in lead vent stack.</li> <li>• New PVC cap installed.</li> </ul>
32		<p><b>Building 8500 Roof Area W1</b></p> <ul style="list-style-type: none"> <li>• Exposed asphalt at perimeter due to protection course sliding down.</li> </ul>

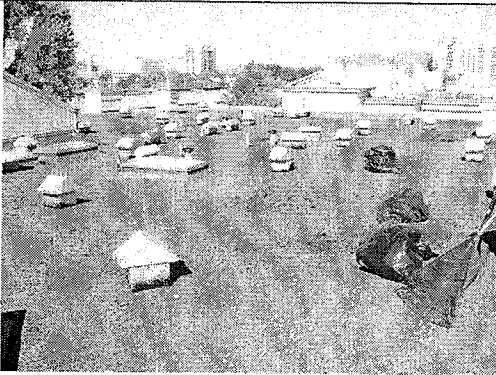
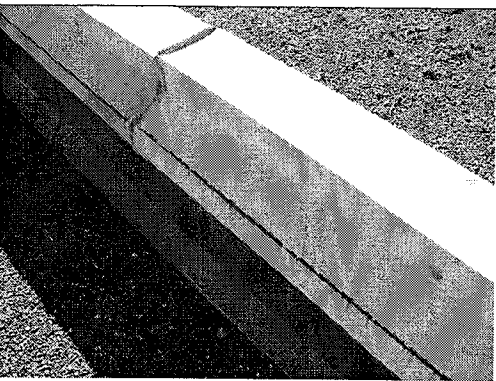
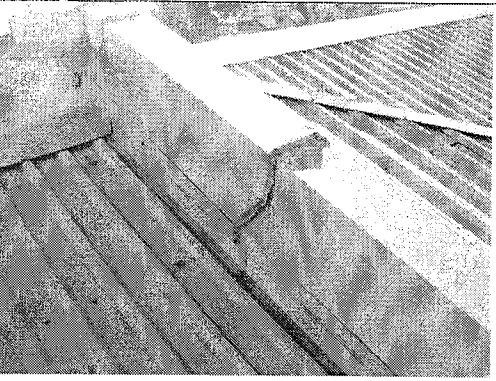

## PHOTOGRAPHS

33		<b>Building 8500 Roof Area W5</b> <ul style="list-style-type: none"> <li>• General view of roof area.</li> <li>• Corrosion to vent box caps.</li> </ul>
34		<b>Building 8500 Roof Area W4</b> <ul style="list-style-type: none"> <li>• Vent cover not secured</li> <li>• Screen not continuous</li> <li>• Vent ducts do not extend to top of vent box.</li> </ul>
35		<b>Arch / Entrance Roof</b> <ul style="list-style-type: none"> <li>• Ponding water.</li> </ul>
36		<b>Building 8500 Roof Area W1C</b> <ul style="list-style-type: none"> <li>• EPDM membrane wrinkling.</li> </ul>


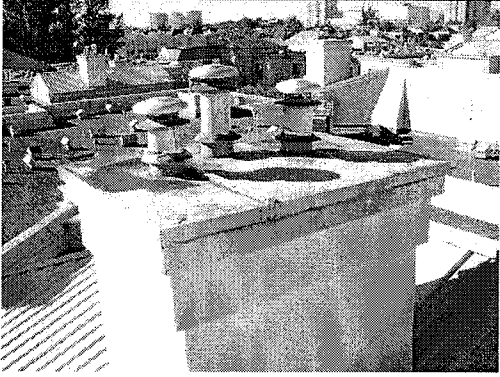
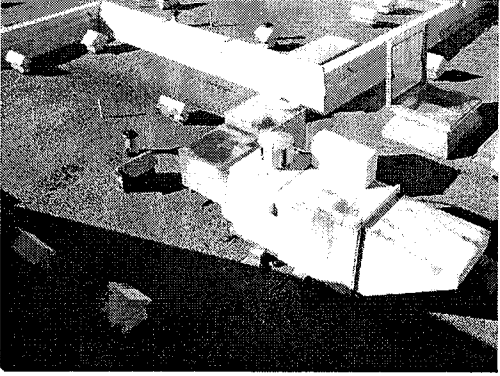
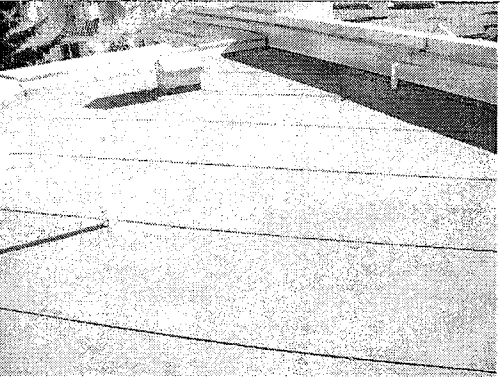
## PHOTOGRAPHS

37		<p><b>Building 8500 Roof Area W1</b></p> <ul style="list-style-type: none"> <li>Sealant at storm collars is deteriorating.</li> </ul>
38		<p><b>Building 8560 Roof Area S4</b></p> <ul style="list-style-type: none"> <li>Exposed asphalt at base of box vent is degrading due to U.V.</li> <li>Cracked asphalt can allow water to migrate behind asphalt.</li> </ul>
39		<p><b>Building 8520 Roof Area S3</b></p> <ul style="list-style-type: none"> <li>Water stained ceiling in hallway outside Unit 318.</li> </ul>
40		<p><b>Building 8520 Roof Area S1</b></p> <p>'B' Vent:</p> <ul style="list-style-type: none"> <li>Exposed asphalt at base has cracked which will allow water to migrate past.</li> </ul> <p>Note: Top of vent has been "painted" to minimize corrosion as part of ongoing maintenance.</p>

## PHOTOGRAPHS

41		<p><b>Building 8520 Roof Area S1</b></p> <ul style="list-style-type: none"> <li>• Removal of moss growth as part of ongoing maintenance.</li> </ul>
42		<p><b>Building 8520 Roof Area S2</b></p> <ul style="list-style-type: none"> <li>• Corrosion occurring to metal cap flashing at firewall.</li> </ul>
43		<p><b>Building 8560 Roof Area S4A</b></p> <ul style="list-style-type: none"> <li>• Caulking at cap flashing over firewall failing.</li> <li>• Cap flashing does not fit/lock together correctly.</li> </ul>
44		<p><b>Building 8560 Roof Area S4A</b></p> <ul style="list-style-type: none"> <li>• Fasteners backing out.</li> <li>• Fasteners are corroded.</li> <li>• Metal roof panels are corroded.</li> </ul>

## PHOTOGRAPHS

45		<p><b>Building 8560 Roof Area S5A</b></p> <ul style="list-style-type: none"> <li>• Membrane used under metal cap flashing is deteriorating.</li> <li>• Metal cap is damaged.</li> <li>• Corrosion to metal roof panels.</li> </ul>
46		<p><b>Building 8520 Roof Area S4B</b></p> <ul style="list-style-type: none"> <li>• Corrosion to top of metal cap flashing.</li> <li>• Sealant at storm collars is failing. Some previous repairs have been completed.</li> </ul>
47		<p><b>Building 8520 Roof Area S4</b></p> <ul style="list-style-type: none"> <li>• General view of roof area</li> <li>• Corrosion to top of mechanical equipment.</li> </ul>
48		<p><b>Building 8560 Roof Area S7</b></p> <ul style="list-style-type: none"> <li>• Minor wrinkling of 2-ply SBS membrane.</li> </ul>

\\Srvr-rmd-bldsci\buildsci\PROJECT\2010PROJECTS\10-1561-00 Queens Gate (Roof Cond Assess)\9\_Final Report\Photos October 28, 2010.doc