Greenhill Water Supply Review

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Prepared for
Greenhill Water Supply Company

Date 3 March 2014

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3 March 2014

Mr Tumi Bjornsson
Director
Greenhill Water Supply Company
PO Box 105
Burnside SA 5065

Dear Tumi

Greenhill Water Supply Review

Please find attached our review of the Greenhill Water Supply (GWS) completed during 2013 and issued in 2014.

The Review includes:

- A report that presents an assessment of the GWS current asset condition, system upgrades and enhancements that have been completed, and potential options for future improvements (Section 1 and 2)
- A one page summary of our desktop assessment of the expected groundwater abstraction licence process for GWS to obtain a new licence (Appendix A).

Inside Infrastructure has completed these assessments for GWS on a pro bono basis as part of our commitment to support community.

If you have any queries please contact either Mr Chris Hughes on 0429 089 258 or Mr Tony Lines on 0419 805 609.

Yours sincerely

Chris Hughes
Engineering Manager

Tony Lines
Principal Advisor

Contents

Executive Summary

The report of the Greenhill Water Supply Company (GWS) dated March 2003 and containing the Constitution of the Greenhill Water Supply Co Ltd gave the day of registration as 23 October 1998 and noted under Item 6 that:

"The objects for which the Company is established are to source, maintain and supply reticulated water to the residents and organisations in the region of the suburb of Greenhill South Australia."

GWS is a community-owned water supply and distribution company formed in response to the Ash Wednesday fires in 1983. A critical function of the water supply system is to provide water for bushfire fighting as is evident by the provision of 30 fire hydrants along Yannagin Road, Yarrabee Road and Greenhill Road.

The water provided by this scheme is not treated and is classified as non-potable. Resident shareholders are required by the company constitution to have an independent water supply for their households.

SA Water helped to develop the scheme, and as a result of their input a change was made resulting in the SA Government granting $146,000 rather than the $100,000 initially requested. While this suggests that the scheme was installed in accordance with the requirements of SA Water, this report re-examines the bore, pipe and tank installation in accordance with SA Water Technical Guideline TG 105 September 2011 *Allowable Pipe Size, Class and Materials for Water Mains* with applicable reference to the *Water Supply Code of Australia WSA 03-2002 Version 2.*

Our assessment is that the existing GWS pipeline is acceptable in accordance with SA Water requirements, which includes the *Water Supply Code of Australia.* This is on the basis that the original installation including pipe bedding, pipe location along roadways, acceptance of the PN12 pipe as 'Specific Project Areas' was accepted by SA Water in their original review with consequent modifications to the scheme.

Our assessments conclude that it is possible to:

- Convert the existing system to a potable supply with a UV disinfection system
- Connect to the existing SA Water potable supply at the Burnside tanks.

Either option requires detailed engineering assessment and design, beyond the scope of this report.

Even if installation of a connection to the Burnside tank is undertaken it still may be efficient to maintain and operate the existing bore, especially in terms of:

- Minimising cost of water
- Reducing pumping costs.

This may be best assessed after the preferred potable supply option is chosen, completed and operational.

The assessment also shows that there are some deficiencies with the current system, but addressing them may not be as difficult as the present GWS operator concerns indicate. This is especially so for the existing reinforced concrete supply tank.

We conclude that it is also possible to obtain a new groundwater abstraction licence for the GWS bore, however there are uncertainties about specific requirements for SA Government (DEWNR) and we recommend discussions between GWS and DEWNR to facilitate obtaining both a groundwater allocation and subsequently a licence. Our desktop review of the required process is presented in Appendix A.

1. Summary of the Existing System

1.1 Existing Layout

The following is the GWC Street Map Technical March 2012 provided by the Operations Manager John Wright at our meeting on Thursday 14 November 2013.

Figure 1 – Street Map

The approximate length and elevation of the main along Yarrabee Road, Greenhill Road and Yannagin Road is shown in the following Google Earth map:

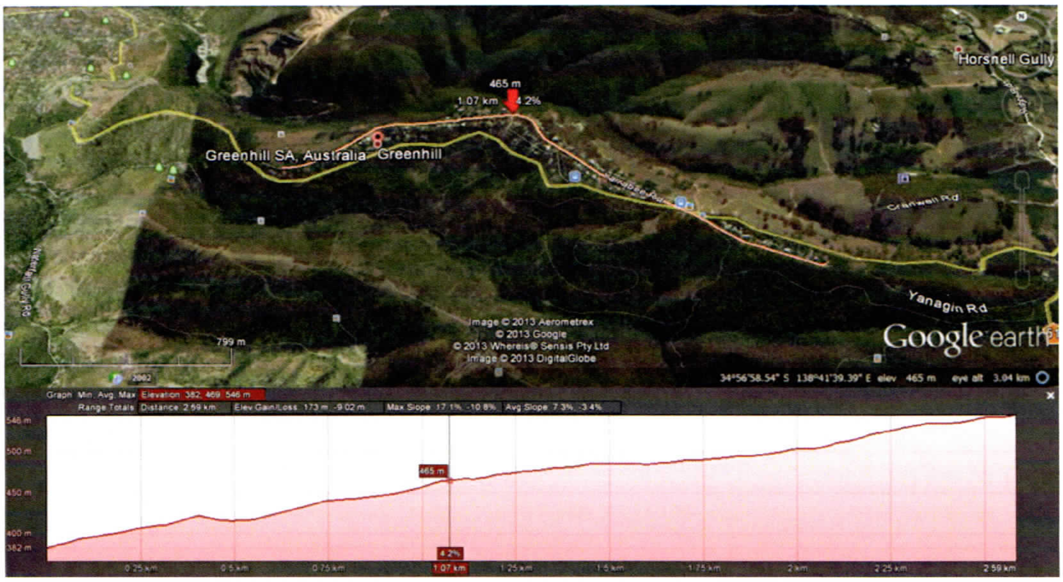


Figure 2 –Google Earth Map

This Google Earth map shows the ground elevation above AHD (not a reduced level that is measured from a reduced datum 100 feet below Low Water of Ordinary Spring Tides (LWOST)) to be:

- EL382 at the lower end
- EL465 for the road level at the connection from the bore (shown as the red arrow above)
- EL546 at the tank site.

This gives 546-465 = 81 m from the connection to the bore to the tank site which when allowing for the height of the tank corresponds to the 85 m maximum pressure (assuming that the pressure reducing valves are operating correctly) quoted in Report 1 by Dare Sutton Clarke (refer Section 1.6).

The elevation between the tank site and the low end of Yarrabee Road at Fire Hydrant 30 is 546-382 = 164 m or just a little greater than the 160 m given in Report 1. The length of this main from Google Maps is 2.59 km.

The connection from the bore to the main in Yarrabee Road is shown in the following Google Earth map:

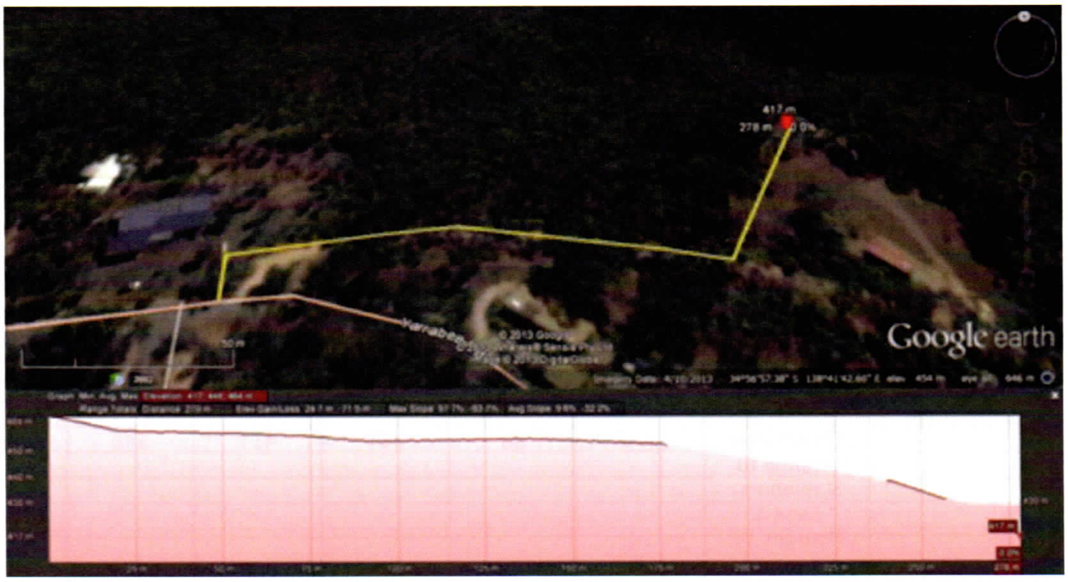


Figure 3 - Google Earth Elevations

Here the ground level shown by Google at the connection to the Yarrabee Road main is EL464.

Report 1 indicated the planned ground level of the bore pump was to be EL430 for which the above diagram has been adjusted resulting in a rise of 464-430 = 34 m.

The length of this main from the bore by Google Maps is 278 m.

Also, the drop to the creek (Second Creek) from Google Maps is approximately 40 m.

The depth of the pump is 145 m (EL285) so about 100 m below the creek bed.

1.2 Existing Pipeline Details

A summary of the installed pipes as indicated in Report 1 (giving the proposed installation) and the GWC Street Map Technical March 2012 is shown in Table 1. Pipe lengths were assessed from a QikDraw plot of this map scaled in accordance with Google Maps. All pipes indicated are uPVC. All levels obtained from Google need checking with a surveyed map and are only indicative.

Table 1 - Pipeline Summary

Location	Length (m)	Nominal diameter (mm)	EL Top	EL Bottom	Pressure EL	Max pressure (m)	Pipe rating PN
Bore to Yarrabee Rd (Max pump rate 8 L/s)	202 (278 - measured from Google)	100	464	430	540 (Report 1 indicates 570?)	110 (at ground level) 120 when pumping	16
Tank to PRV1	1201	100	540	472	540	68 (75 when pumping)	16
PRV1 to PRV2	326	100	472	460	540	80 (85 when pumping)	16
PRV2 to PRV3	389	100	460	432	517	85 (113 with PRV fail and pumping)	16
PRV3 to Dia change (Block 48)	155	100	432	416	467	51 (129 with PRV fail and pumping)	16
Dia change to Hydrant 30 (Western end)	516	80	416	382	467	85 (163 with PRV fail and pumping)	16
Reticulation mains							
From bore main	176	50	459	457	540	83	12?
Christopher Avenue to Hydrant 12	244	80	481	457	540	83	12?
Christopher Avenue to Staplehurst Lane & Hydrant 16	374	80	481	451	540	89	12?
Hillside Road to Hydrant 22	106	80	446	439	517	78	12?
Hillside Road to Hydrant 23	37 23 20	100 80 50	444	418	517	99	16 12?
Yarrabee Rd Blocks 74/76 to Block 755	88 83	50 25	442	431	517	86	12?
Yarrabee Rd Blocks 54/56 to Hydrant 26	196 68 38	80 50 50 (AV 5)	423	397	467	70	12?
To CFS 45,000 L fire water tank	39	25	416	413	467	70	12?
General block services	Varies up to about 24 m	25		380 for Block 2	467 for Block 2	87 for Block 2 (160 with PRV fail)	12?

The above table indicates that the pipes installed are adequate for the pressures involved provided the pressure reducing valves are all working correctly. If the PRVs were to fail pressures would increase to a maximum of about 160 m under static load from the high level tank or 165 m if the bore pump were operating.

Therefore the Class 16 pipes (160 m design pressure) are adequate but the Class 12 (120 m design pressure) reticulating mains are inadequate to cope with an unlikely PRV failure. It was reported at our meeting on 14 November 2013 that the PN12 pipes are now being gradually replaced with PN18 pipes (180 m design pressure, the grade now provided) which is a reasonable strategy.

The requirement of the SA Water Technical Guideline TG105 *Allowable Pipe Size, Class and Materials for Water Mains* specifies a minimum class of PN16 uPVC for a water supply network standard installation, which the major distribution mains meet. A PN12 class uPVC main is acceptable in specific project areas provided these areas are approved by SA Water.

The reason for requiring a minimum of PN16 is to ensure a 100 year life while providing for the effects of long term fatigue as well as limiting the development of ovality during installation with consequent problems. The lower grade pipes have been accepted for use in the irrigation industry where a 25 year life is acceptable.

Thus, as a long term security measure the replacement of the existing PN12 pipes with PN18 pipes should continue as was advised is presently being undertaken.

The Water Supply Code of Australia and consequently SA Water specifies a minimum diameter of DN100 for water mains with fire fighting capability. As shown above many of the fire hydrants are located on smaller diameter mains down to DN50 for Hydrant 26. However, Hydrant 4 on Greenhill Road between Yannagin Road and Yarrabee Road, which comes off the DN100 PN16 main was advised as the priority hydrant for fire fighting because of the ready access for fire trucks.

Also, it is understood that the water mains are primarily for supplying water to home tanks prior to a fire, and that the fire hydrants along the main are for filling emergency services water tankers during fire fighting. Thus fire fighting water for all homes is to be pumped from these tanks, or is to be provided from fire trucks. The minimum required tank size at homes is 22 kL, which would provide 2 L/s for 3 hours at each home.

The maximum rate of supply to homes from the water supply system of 13 L/min (comparable to a slow running domestic tap) is insufficient for fire fighting (a full pressure domestic tap can supply 30 to 40 L/min).

Domestic high level rotating sprinklers were observed on homes but without checking these in detail, it is assessed that the 13 L/min supply from the bore would not provide fire fighting water for more than one of these. As fire intensities vary considerably this needs assessment by professional fire fighting professionals.

Thus, provided homes have an appropriately protected tank of at least 22 kL which is maintained full and a reliable pumping system which can be assured to continue to operate under serious fire conditions, the existing pipeline installation is acceptable for SA Water requirements for fire fighting capability.

1.3 Pipeline Fittings

Pipeline fittings were advised to be continually monitored during operations and upgraded as required. Ball valves are being replaced by stainless steel gate valves. Inspection of the pipework from the bore pump (see Photo 3) showed this to be of good quality and well maintained.

1.4 Bore Pumping Station

The bore pumping station is shown in the following photographs:

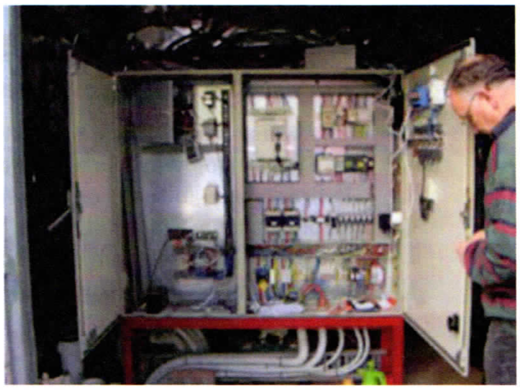
Photo 1 - Sheds

The shed on the right contains the switchboard and backup battery. Power is supplied by an underground cable. Ground level is at EL430.

The smaller shed on the left contains the bore and headworks.

While it is understood that there is fire protection inside and the sheds are distant from all but one tree, there is little protection from a serious fire. A surrounding fire wall has been proposed.

Photo 2 - Switchboard



The 415V 3 phase switchboard supplying electrical power to the 30 kW 34 stage Grundfos pump through a recently replaced 60 amp 3 phase plus earth flexible cable.

The control system incorporates:

- Flow switch
- Low pressure switch
- Pressure sustaining valve
- Surge anticipation valve.

Note the back up battery in the bottom left hand corner.

Photo 3 – Bore Headworks

Stainless steel pipework in bore shed. Bore is at the far right end. Should the bore pump need removal the shed around the far end can be unbolted and removed.

The pipework looked to be in excellent condition. The blue valve is a pressure sustaining valve, the box behind is a pressure switch and the black unit on the left is a flow switch. The round lid at the bottom is a bore sanitiser.

Report 1 by Dare Sutton Clarke understood that the design flow is 8 L/s.

Further details are provided in Report 2 'Functional Requirements for System Upgrade and Enhancements'.

1.5 Tanks

There are two tanks in the system as shown below:

Photo 4 - Fire Water Tank (CFS Asset)

This tank is owned by the Country Fire Service (CFS)

Corrugated steel fire water tank of 45 kL capacity located at the fire station. This is fed through a 25 mm uPVC pipe and appears to be for the supply of fire fighting water as with house tanks.

Photo 5 - Distribution Tank

Reinforced concrete system distribution tank of capacity 508 kL, approximately 13 m diameter x 4.15 m high. This is located at the high end of Yannagin Road.

Ground level is at EL540. With the tank set 1 m in the ground the high water level would be approximately EL543.

The two cabinets at the front are for water level control and wireless communication with the pump station.

Photo 6 - Control/Communication Cabinets

Inside are the water level control and wireless communication cabinets. This was reported to not be working adequately and is proposed to be upgraded, see Report 2 'Functional Requirements for system Upgrade and Enhancements'.

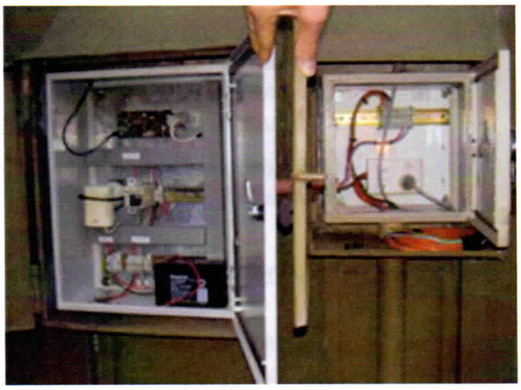


Photo 7 - Tension Crack

Weep from a vertical tension crack in the upper half of the tank. While small, this crack appears to have been of sufficient size to permit enough flow to prevent autogenous healing to occur.

The dark deposit is not iron oxide and there is no indication of corrosion of the reinforcement. In the long term such flow can result in the carbonation of the lime in the cement gel so lowering the pH of the pore water resulting in loss of the protective film on the reinforcement enabling corrosion to then occur.

Photo 8 - Suspected compaction crack

A more significant leak which appears to be in the second ring beam pour is shown on the right.

The crack is at an angle suggesting it is the result of pouring the wet concrete in one direction around the formwork ring. Placing concrete in such a way means leaving one face at an angle and not compacted. When the placing of the concrete extends right around the ring it is then necessary to fully compact the concrete by vibration right through this contact face.

Report 6 (refer Section 1.6) also noted there was honeycombing on the inside face at this point indicating this joint was not properly compacted possibly as a result of a delay in making the connection. (With larger tanks the concrete is placed in both directions so the final connection is of freshly placed concrete.)

Again the dark deposit is not iron oxide and there is no indication of corrosion of the reinforcement. Possibly it is an iron bacteria from the water which could indicate a need for bromide treatment (check).

There has been other seepage from both the horizontal joints and vertical tension cracks which has been satisfactorily sealed by autogenous healing as shown on the picture of the tank above. This is normal for such tanks as they are designed in accordance with AS 3735-2001 *Concrete structures for retaining liquids* to crack in tension but with the crack widths limited so such healing will take place.

Overall the concrete looked to be of good quality appropriate for a potable water storage tank. Report 6 also found the concrete cover to the reinforcement to be satisfactory.

With a storage capacity of 508 kL this indicates a water storage depth of 3.83 m giving a freeboard of 32 cm. Counting the blocks of land there are 166. If each was to be supplied with water at an average of 13 L/min this would be 166 x 13 = 2,158 L/min from the tank or 3.9 hours to empty it. Filling at 8 L/s would take 17.6 hours.

If all 166 land blocks had a 22 kL tank this would amount to 166 x 22 kL = 3,652 kL to be provided of pumping continuously from the bore at 8 L/s for 5.3 days.

1.6 Reviewed Reports

Reports and documents that were provided by GWS included:

1) 22 March 2000, Dare Sutton Clarke Engineers, 276 Flinders Street, Adelaide SA 5000
Proposed Greenhill Water Supply Scheme
This report examines the proposed scheme for a reticulated water supply to the suburb of Greenhill in the Adelaide Hills.

2) April 2011, Version 1.0 6th, John Wright, Operations Manager, Greenhill Water Supply Company Ltd
Functional Requirements for System Upgrade And Enhancements
The infrastructure was installed in the year 2000. Since installation the infrastructure has remained basically unchanged with little or no upgrades.
The purpose of this specification is to outline system upgrades and enhancements that are required to guarantee reliable performance in the future.

3) September 2011, Version 1.3, John Wright, Operations Manager, Greenhill Water Supply Company Ltd
Request for Proposals - Water Storage Tank Repairs
GWS's 508 kL reinforced concrete water storage tank was built in the year 2000 by

Roctor Tanks Pty. Since the tank was built, a number of issues associated with leaking have developed that need to be addressed to prolong the life of the tank. This specification seeks proposals from suitably qualified and experienced providers for the repair of leaks in the tank and to prevent the development of further leaks.

4) 14 September 2011, Swart and Sons Pty Ltd, PO Box 331, Unley SA 5061
RE: Job Ref 11.106 - Waterproofing To Greenhill Water Tank
This is a tender amounting to $40,700 (including GST $3,700) for undertaking repairs to the tank and providing a 10 year warranty.
The work tendered included grit blasting the internal wall followed by brushing a polylene gauze into selected corners i.e. wall to floor junction then applying two coats of TAM 10F at a rate of 3.5 kg/m^2.

5) 26 September 2011, Nova Group, 6 Pattinson Road, Newton SA 5074
Waterproofing To Greenhill Watertank - Quotation No 4625
This tender provided three options:
Option 1 $23,914 with 10 year warranty to pressure clean the internal surface and apply 3 coats of Ardex WPM300 hydropoxy waterproofing membrane used in conjunction with Ardex Deck web between coats 1 & 2.
Option 2 $24,420.00 with 10 year warranty to pressure clean the internal surface, prime the surface using Gripset 11y and Dm as slurry coat then installing 2 coats of Gripset 2P to achieve dry film thickness of 2mm and finally installing a topping coat of Gripset 11y/Dm slurry to entire membrane.
Option 3 $45,386.00 with 20 year warranty to pressure clean the internal surface, prime surface using Gripset 11y and Dm as a slurry coat over entire surface then installing 2 coats of Gripset 2P to achieve a dry film thickness of 2mm embedded with Gripset open weave reinforcing fabric and finally installing a topping coat of Gripset 11y/Dm @ 5mm thickness to the entire membrane.

6) 17 November 2011, f=mg Engineering, 42 Fullarton Rd, Norwood SA 5067, Ref: M109691/MRB
Re: Concrete Water Tank Leaks, Site: No. 37 Yannagin Road, Greenhill SA 5140
This report is the assessment of the 508 kL approximately 13 m diameter x 4.15 m high reinforced concrete tank inspected when completely emptied allowing internal access.
Inspection included assessment of reinforcement cover by use of a non-destructive Profoscope rebar detector indicating cover to the reinforcement between 50 mm and 60 mm which is acceptable in accordance with AS 3735-2001 *Concrete structures for retaining liquids* providing the characteristic strength of the concrete was 32 MPa or greater.
Conclusions of this assessment are that the tank is sound with the minor cracking being adequately sealed by autogenous healing (which such a tank is designed to happen) and some honeycombing and non healing leakage appearing to have been caused by inadequate compaction (especially at what appears to be a dry contact with the wall form being filled in one direction only) to be repaired by injecting a hydrophilic polyurethane flexible seal.

2. System Upgrade and Enhancements

2.1 Existing Pipeline and Fittings

The assessment is that the existing pipeline is acceptable in accordance with SA Water requirements, which includes the Water Supply Code of Australia. This is on the basis that the original installation including pipe bedding, pipe location along roadways, and acceptance of the PN12 pipe as 'Specific Project Areas', was accepted by SA Water in their original review with consequent modifications to the scheme.

As shown in Table 1, all of the major water supply network mains meet both diameter and pressure rating requirements as specified in SA Water Technical Guideline TG105 Appendix A.

The smaller distribution mains are acceptable under Clause 3.4 of TG105.

As a precaution due to the remote possibility of the pressure reducing valves failing, the gradual replacement of the PN12 pipes by PN18 pipes is recommended to continue.

Pipeline fittings observed were assessed to be of appropriate quality. The maintenance and replacement of pipeline fittings as required was observed to be undertaken with appropriate quality replacements.

2.2 Electrical and Electronic (Wireless) Equipment

The specification prepared by John Wright, Operations Manager for GWS 'Functional Requirements for System Upgrade and Enhancements' Version 1.0 provides a thorough assessment of the system and each of the items appears appropriate to ensure efficient and reliable operation.

These upgrades should be continued ensuring that they are able to be operational in case of extreme fire. This includes provision of alternative pump power supply, such as a diesel generator for both the bore pump and each house pump. Other options may also be possible, but have not been examined.

Additionally, adequate fire protection at the sheds such as the proposed fire wall at the bore pump, and possibly checking of all installed sprinkler systems to ensure adequate operation under extreme fire conditions, needs to be provided.

2.3 Water Supply Tank

The assessment of the reinforced water supply tank is that it is basically sound for storage of water extracted from the bore (and potable water), but requires some minor repair work on excessively leaking joints. The Report 6 advice involving sealing of excessively leaking joints by the equivalent of epoxy grouting is sound and adequate.

All tanks such as this are designed in accordance with AS 3735-2001 *Concrete structures for retaining liquids* to crack in tension but with the crack widths limited so that leakage will be controlled by autogenous healing. To endeavour to do otherwise would result in an excessively expensive and non practical tank.

Full sealing of this tank as per the tenders given in Reports 4 and 5 is not recommended as it is a very inefficient way of sealing the leaking cracks and there is little benefit to the durability of the concrete with the nature of the water being stored. If such a lining were to be installed it becomes essential to ensure there is sufficient flexibility at each crack for the liner to stretch without tearing as the cracks in the brittle concrete move under loading. If a flexible non-adhering liner was to be installed this must be well sealed at all openings such as tank inlet and outlet as well as provided with a drainage system to remove any unexpected leakage which might occur over time.

A critical issue with this tank in an extreme fire danger situation is that it and each home tank has sufficient water to provide for the fire fighting requirements. As noted under Section 1.5 the tanks would:

- Take 3.9 hours to empty it if it was feeding 166 blocks of land at 13 L/s each (which is insufficient for fire fighting but could provide partial replenishment to home tanks or maybe feed one of the high level sprinklers)
- If empty it would take 17.6 hours to fill from the bore
- If all 166 land blocks had an empty 22 kL tank it would take 5.3 days to fill them.

While such extreme conditions of all tanks being empty is extremely unlikely during normal operation, it is likely that most tanks would only be partly full so that their full capacity would not be available for extreme fire fighting.

A possible consequence of this is a need for a special reserve of readily available water such as a second tank always kept full. A suitable site was advised to be available at a higher level than the existing tank. While this is a possibility the cost of building another tank similar to the existing one needs consideration.

Should another tank be considered it is still necessary to ensure the water remains of a suitable quality to be fed through the pipe system to homes. With long term storage this may be at risk unless the second tank is regularly treated or is used on-line but with the total retention of water always sufficiently maintained for fire fighting purposes.

Another option could be access to a supply of water from SA Water's Burnside Tanks located approximately 1.5 km to the north-west of the lower end of the Greenhill system (Hydrant 30).

2.4 Provision of Potable Water Enabling Drinking

There are a number of ways of treating water to ensure it is suitable for human consumption. For the GWS situation, it would require ensuring there are no microorganisms and biofilms, and treatment such as ultraviolet, ozone, chlorination and chemical are possible.

Chemical treatment such as used in domestic tanks is impractical (e.g. requiring dosing the supply tank with 40 kg at regulated intervals). Chlorination with the need to provide chlorine gas with reliable dosing is also considered impractical for this situation (chlorination such as with a swimming pool is unsuitable as this requires salt in the water to about a quarter the level of sea water - 10,000 mg/L).

Ultraviolet and ozone treatment, while there are still limitations, have the advantage that no health-endangering by-products are formed in the water and the natural taste and smell of the water is also preserved.

The following provides some information on ultraviolet and ozone treatment from Xylem Water Solutions Herford www.wedeco.com wedeco.de@xyleminc.com.

2.4.1 Ultraviolet (UV) light disinfects without chemicals

The use of chlorine, chlorine dioxide, hypochlorite and other chemical substances for the disinfection of drinking water can entail health-related and ecological disadvantages due to the formation of chemical by-products. Besides, some dangerous pathogens such as Cryptosporidium and Guardia are already very resistant to chemical disinfection techniques.

Disinfection with UV light is more effective because microorganisms are inactivated by a photochemical reaction between the UV-C radiation and the genetic information carrier (DNA) of the pathogen within seconds. The pathogen cannot multiply anymore and dies. Since this is a purely physical technique, the pathogen types cannot become resistant to the UV radiation in addition. The WEDECO UV technology can thus replace the use of chlorine completely or reduce it to a minimum.

The advantages of UV disinfection for the water utility are:

- The inactivation of microorganisms takes place within seconds, even in the case of resistant bacteria, viruses and parasites (e.g. Cryptosporidium and Guardia)
- Replaces or reduces drastically the use of chemicals
- No reactor vessels or secondary pumps
- Technology successfully tried and tested
- The technique is low-maintenance and handling is simple
- Low operating costs, if UV low-pressure emitters are used
- Low investment costs.

2.4.2 Ozone oxidation in drinking water treatment

The use of ozone is often the only and most effective technology for providing high-quality drinking water. Thanks to the environmentally-friendly way in which it works, it is ideally suited for the sustainable water treatment. As the strongest technically producible oxidising agent, it fulfils numerous "special tasks" apart from disinfection, which cannot be carried out using other methods or only with difficulty:

- Disinfection, i.e. killing of microorganisms (giardia lamblia /virus inactivation/ elimination of cryptosporidia)
- Removal of smell (deodorisation)
- Removal of humins (decolourisation)
- Taste enhancement
- Oxidation of iron and manganese
- Degradation of pesticides, pharmaceutical residues and other trace contamination
- Support and partial replacement of flocculants

The advantages of ozone oxidation for the water utility are:

- No formation of haloforms
- Low ozone quantities are necessary
- No environmental or health-endangering by-products
- pH insensitivity
- Ozone is produced according to needs at the place of consumption from energy and oxygen/air
- Modern technology with drastically reduced energy consumption/optimised ozone production.

The advantages for humans, animals and the environment are:

- No environmental impact - ozone disintegrates or is broken down into oxygen after the reaction
- The water keeps its natural taste and smell
- No formation of harmful by-products.

2.4.3 Example of a Possible Ultra-Violet Water Steriliser

As an initial assessment, an ultra-violet water steriliser appears to be the most appropriate method of treating the bore water to make it potable and suitable for human consumption.

The Steriflo unit by Davey Products Pty Ltd of 6 Lakeview Drive, Scoresby, NSW 3179 is an example of a practical and economic system.

To treat water flowing at the rate of 8 L/s (480 L/min), 4 x UV-130-40 units would be required. Each of these can operate at a maximum of 130 L/min.

Details of these units have been provided by Mr Don Checker of AEM Consolidated Pty Ltd, 571 Grand Junction Road, Gepps Cross SA 5049, Phone: (08) 8162 5957, Email: info@aemgroup.net.au www.aemgroup.net.au as follows:

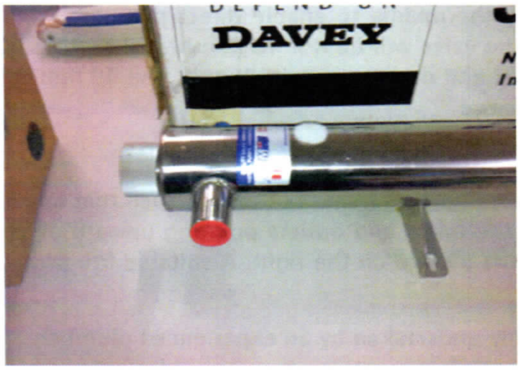
- Cost for 4 x UV130-40 units $9,072 ($2,268 each) including GST
- UV lamps GPH 84 ON2/S $113.99 each including GST - 1 year expected operational life.

From this it is seen that the power consumption is 85 watts per unit (340 watts total) which is small compared with the power for the bore pump and that the maximum operating pressure is 850 kPa.

Thus this unit cannot be operated at the location of the bore. The optimum location is then just before the connection into the pipe main in Yarrabee Road where treated water would always be fed into the distribution system. If the UV unit was placed at the system tank then untreated water would be fed into the distribution system and could find its way into homes. For the reticulation main fed from the line from the bore to Yarrabee Road it would be necessary to install a new connecting 50 mm PN18 oPVC pipe and blank off the existing branch from the bore main.

Specification Data Sheets – Steriflo (Photos 9-11)

The following photos and graphics show in more detail each end with the inlet and outlet connections and the caps for accessing the UV protective shield and lamp.



Photos 9-11 Example UV Steriliser

The picture below shows a similar but smaller unit (UV40-20) with the power supply to the UV lamp at the right hand end.

Photo 12- Alternative example of alternative UV steriliser

Other Installation Requirements

Installation will require a grade 304 stainless steel manifold preferably 100 mm diameter otherwise not less than the diameter of the main in the bore shed. This will be a continuous pipe with a gate or ball valve in the middle to enable direct pumping from the bore to the tank if required. Either side of the valve will be 4 x 40 mm branches with 40 mm ball valves for connection to the 40 mm inlet and outlet on each UV unit. The 40 mm valves are required for when a UV lamp is to be replaced.

All valves should be compatible with the stainless steel manifold.

The UV units will be bolted to a supporting frame but placed such that any air will be pushed through, e.g. if horizontal with the inlets and outlets pointing upward or positioned upward with the outlet at the top as in the picture on the right. A suitable fire protected shed will be required to protect the unit.

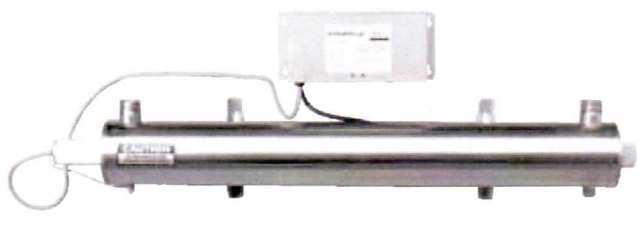
Such installation should be readily undertaken by an experienced plumber.

inside infrastructure

STERIFLO®

Model Numbers: **UV40-20**
UV75-25
UV130-40

DEPEND ON
DAVEY
WATER PRODUCTS



Also available in 110 or 220 volt 60Hz single phase.

ULTRA VIOLET WATER TREATMENT SYSTEMS

PRODUCT DESCRIPTION

Ultra violet water treatment system with stainless steel chamber, UV lamp and control box.

APPLICATIONS

The Davey Steriflo® domestic UV water disinfection systems are an effective and economical means of eliminating harmful bacteria from drinking water supplies. They can also be used for small scale waste water disinfection at reduced flow rates.

- No chemicals
- No taste
- Impossible to overdose

PRINCIPLES OF OPERATION

UV is commonly used for water disinfection on a wide range of water sources by many local councils, the food, dairy and brewing industries and by thousands of private consumers to ensure their water is safe to drink.

UV light at the wavelength generated by the lamp in a Davey Steriflo® unit (254nm) is lethal to most micro-organisms as it damages their ability to reproduce. The organism is then no longer viable as it cannot grow to cause infection or be counted on a culture plate.

It has been shown that cysts such as Giardia and Cryptosporidium are inactivated by UV but the water has to be very clean and free of particulate matter. Therefore filtration is part of all cyst control recommendations from Davey.

FEATURES & BENEFITS

The design of the Davey Steriflo® range of UV sterilisers is intended to provide many years of reliable operation at an economical price. The treatment chambers are 304 stainless steel for cleanliness and long life.

The Davey Steriflo® system is designed for continuous operation treating cold water (up to 45°C) at any flow from zero up to the design flow rate. Extended periods of zero flow are not harmful as long as the treatment chamber is full of water. Allow 2 minutes warm up from switching on before starting flow. Allow 24 hours operation for a new lamp to develop full output.

The Davey Steriflo® range is suitable for potable water and food industry use. All wetted components are USDA listed.

Lamps are single ended for ease of servicing and connection.

Disassembly for cleaning of the quartz sleeve is quick and user friendly with positive sealing at both ends.

The power supply should be mounted in a dry location. 1 metre of lead to the lamp is provided.

Installation can be horizontal or vertical and piping should be arranged so that the unit stays full of water. If horizontal, the inlet and outlet should point upwards, if vertical the inlet should be at the bottom. Mounting brackets are provided for easy installation.

All units are supplied with full installation and operating instructions to ensure proper usage and assist with long term maintenance.

Warning: UV light is harmful to eyes and exposed skin. A safety notice is included with the operating instructions. NEVER LOOK AT A UV LAMP WHEN IT IS SWITCHED ON.

Pre-treatment (drinking water)
Prefiltration is usually to ensure that particulate matter does not shield micro-organisms from the UV light. Depth sand filtration or 20 micron cartridge filtration is the usual minimum. In some cases, particularly with surface water, finer filtration may be necessary, or if cysts like Giardia or Cryptosporidium may be present. In this case 1 micron filtration is required, not necessarily for the whole supply, filtration for the drinking tap only may be practical.

OPERATING LIMITS

	UV40-20	UV75-25	UV130-40
Maximum effective flow (clean water)	40lpm	75lpm	130lpm
Head loss @ maximum flow		< 0.5 metres	
Maximum pressure		850kPa	
Treatment chamber test pressure		1035kPa	
Minimum/maximum water temperature for lamp effectivity		8°C / 45°C	
Maximum ambient temperature		50°C	
Inlet size BSP(M)	3/4"	1"	1 1/2"
Outlet size	3/4"	1"	1 1/2"

HQ & MFG SCORESBY Quality System
Quality Endorsed Company

TECHNICAL SPECIFICATIONS

MATERIALS OF CONSTRUCTION

PART	MATERIAL
Material	304 stainless steel
Number of lamps	One
Number of sleeves	One
Sleeve material	High purity quartz
Number of orings	Two
Oring material	EPDM rubber
Design lamp life	9000 hours (1 year continuous operation)

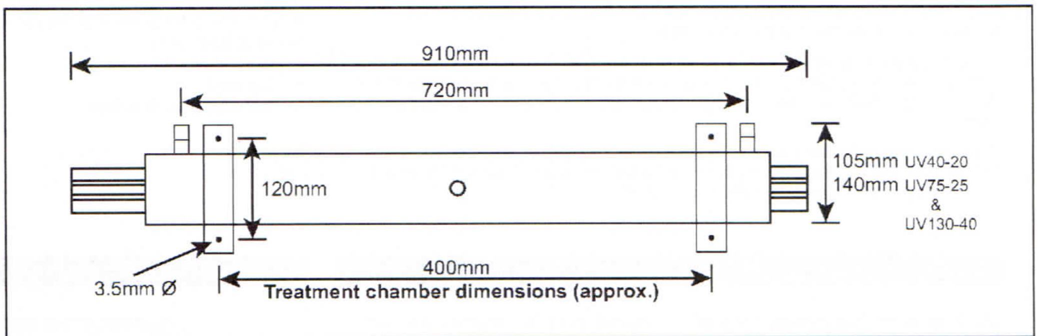
ELECTRICAL DATA

	UV40-20 & UV75-25	UV130-40
Voltage/frequency (std)	230-240V/50Hz	
Options	110V/60Hz or 220V/60Hz	
Power consumption	55 watts	85 watts
Lamp power	40 watts	65 watts

POWER SUPPLY ENCLOSURE

	UV40-20 & UV75-25	UV130-40
Fuse	1A	
Protection rating	For use under cover	IP55
Material	Polyester powder coated steel	ABS
Mains on indicator	Orange	
Visible alarm indicator	Red	
Audible lamp failure alarm	In-built	

DIMENSIONS



	UV40-20	UV75-25	UV130-40
Inlet / outlet size	20mm (¾")	25mm (1")	40mm (1½")
Treatment chamber weight	2.5kg	4.0kg	4.5kg
Treatment chamber mounting brackets	Stainless Steel fixed		
Power supply enclosure dimensions (WxHxD)	250 x 110 x 60mm		190 x 300 x 175
Power supply enclosure weight	1.5kg		12.5kg
Interconnecting cable supplied	1m standard		
Power supply lead	1.7m with 3 pin plug		

All dimensions in mm unless otherwise stated.

All Davey Steriflo® systems are designed and built in New Zealand. Technical support and parts are always available.

This literature is not a complete guide to product usage. Further information is available from your Davey dealer, Davey Customer Service Centre and from the relevant product Installation and Operating Instructions. This data sheet must be read in conjunction with the relevant product Installation and Operating Instructions and all applicable statutory requirements. Product specifications may change without notice.

Visit Davey on-line for further information www.davey.com.au

DEPEND ON DAVEY

WATER PRODUCTS

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E-mail: sales@daveynz.co.nz

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Ph: +1 630 898 6976
Fax: +1 630 851 7744
Website: www.daveyusa.com
E-mail: sales@daveyusa.com

DPM177-1/5K/0706/SC supersedes DPM177/5K/0305/GPW

2.5 Alternative Water Supply Option from SA Water Burnside Tank

There are two SA Water tanks at Burnside, the lower one on Thorpe Road and the higher one to supply higher Burnside homes further up the steep heel between First and Second Creeks. This is the hill which extends further by approximately 1.5 km up to Greenhill.

Provision of water from SA Water would be more reliable especially in an extreme fire situation and always potable for human consumption. Cost of supply however, could be higher.

A number of options for providing water from the high level tank could be possible including:

- GWS to install a new main from and a new pump at the Burnside tank and purchase water at the tank cost
- SA Water to install and operate a new pump at the Burnside tank with GWS to install a new main from this tank and purchase water at the tank cost
- SA Water to install a new main from and pump at the Burnside tank to feed water into the GWS system at Greenhill with GWS to purchase water at the delivered to site cost
- SA Water to purchase the GWS system at Greenhill to install a new pump and main from the Burnside tank, to install SA Water meters on each property and to operate and charge for water as any other suburb. This may involve isolating the existing bore from the system which would remain the property of GWS.

The Google Map below (Figure 4) shows the two Burnside tanks and the track, which extends to Greenhill. Second Creek valley is at the top right:

Figure 4 - Google Map - Burnside Tanks

Photo 12 - SA Water Burnside Tank

The picture shows the higher of the two SA Water tanks.

Photo 13 - Track above Tank to Greenhill

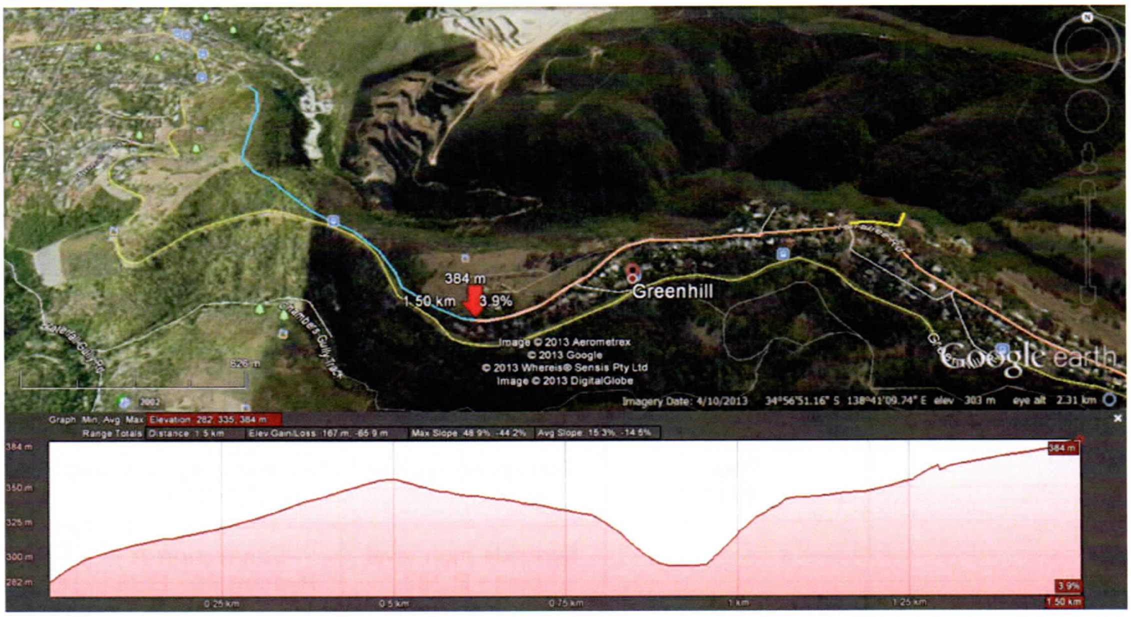
The picture shows the track above the above tank up to Greenhill.

Photo 13 - Hill from Burnside Tank to Greenhill

The picture was taken from the site of the fire station, and shows in the centre the hill above the SA Water Burnside tank which the track shown above traverses.

The route from the Burnside high level tank to the western end of the Greenhill main (at Hydrant 30) is shown as the light blue track together with the elevation details in the following Google Earth map (Figure 5).

Figure 5 - Google Map - Burnside Tanks route



An assessment of the static head required for supply from the Burnside tanks indicates:

- The Google elevation at the high level tank is EL282 with the elevation of the connection at Hydrant 30 is EL384 (Report 1 notes this level as EL380).
- With the high water level in the tank at EL543, this gives a total static head required of 543-282 = 261 m from the high level Burnside tank and 543-384 = 159 m from the connection at Hydrant 30.

For pumping, in addition to this static head, must be added the hydraulic frictional losses which approximately are as in the following table:

Table 2 - Estimated pumping friction losses

Flow L/s	Friction loss per 1,000 m		
	100 mm PVC-O	80 mm PVC-U	100 mm PVC-U
8	5.2	25	8
10	7.5	40	12
16	15	110	28

Thus with the length of each individual section from the Burnside high level tank to the Greenhill supply tanks being:

- Burnside to Hydrant 30 connection -100 mm PVC-O - 1,500 m
- Hydrant 30 connection to diameter change at Block 48 -80 mm PVC-U - 516 m
- Diameter change at Block 48 to supply tank -100 mm PVC-U - 2,071 m,

the estimated hydraulic friction loss becomes:

Table 3 - Estimated Friction Loss from Burnside tanks to GWS

Flow L/s	Friction loss m		
	100 mm PVC-O 1,500 m	80 mm PVC-U 516 m	100 mm PVC-U 2,071 m
8	7.8	12.9	16.6
10	11.3	21	25
16	23	57	58

Thus the pressure head in the pipe becomes the addition of static head and friction losses:

Table 4 - Estimated Total Pressure Head from Burnside tanks to GWS

Flow L/s	Total pressure head when pumping with supply tank just filled to EL543 (m)		
	Burnside high level tank - EL282	Connection at Hydrant 30 - EL384	Diameter change at Block 48 - EL416
8	298	189	144
10	318	205	152
16	399	274	185

As can be seen from this table, and the existing pipe pressure ratings (Figure 1), the total pressure heads are acceptable for the pipe pressure ratings on the section of pipe between the diameter change at Block 48 and the distribution tank even with a flow of 10 L/s.

However, the existing 80 mm pipe between Fire Hydrant 30 and the diameter change at Block 48 is not adequate for the total pressure head required.

For a new pipe from the Burnside high level tank it would be necessary to replace this section of the existing pipe and install either (in order of preference) a:

- Ductile iron pipe such as a DN100 Tytonxcel PN35
- Mild Steel Cement Lined (MSCL) pipe.

To work effectively this pipe would need extending at least to the diameter change at Block 48 making it a total length of 2,016 m. This route length could be slightly reduced by taking this new pipe along what is referred to as the 'Unknown Street' (Figure 1). At the higher elevations along the route, the pipe class could be reduced to a PN20 to reduce cost.

Such an upgraded system could carry 10 L/s from Burnside tank to the distribution tank. For the long term future where the demand on the GWS system may increase, a careful assessment of whether it is prudent to increase this pipe size from DN100 to DN150.

Costs have not been determined but based on experience with similar systems, something like $0.5 million should be considered for budgeting purposes. A connection to the Burnside tank would make the GWS system more reliable and also avoid costs of installation of a second distribution tank and also the ultra-violet water treatment plant as well as limiting operating and maintenance.

2.6 Conclusions

Our assessments conclude that it is possible after further assessment and engineering design to:

- Convert the existing system to a potable supply with a UV disinfection system
- Connect to the existing SA Water potable supply at the Burnside tanks.

Even if installation of a connection to the Burnside tank is undertaken it still may be efficient to maintain and operate the existing bore, especially in terms of:

- Minimising cost of water
- Reducing pumping costs.

This may be best assessed after the preferred potable supply option is chosen, completed and operational.

The above assessment shows that there are deficiencies with the current system, but addressing them may not be as difficult as the present GWS operator concerns indicate. This is especially so for the existing reinforced concrete supply tank.

In terms of preparedness for an extreme fire situation there are serious concerns about the system to supply the required rates of flow to users and the fire protection of the bore, power supply, but this is beyond the scope of our assessment and needs careful consideration by GWS and assessment by experienced and qualified personnel.

Both modifications to the existing scheme and revisions of the present operational system may need careful examination.

The upgrades which have been proposed - see Reference 2 above 'Functional Requirements for system Upgrade and enhancements' by John Wright, Operations Manager look to be thorough and sound and are the first steps to make the system acceptable for secure water supply and fire protection.

Appendix A – Groundwater Licence Process

Greenhill Water Supply - Water Licence Application Process