GRAVESTONE CONSERVATION REPORT

ELIZA RODD 1831

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as a volunteer project
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ELIZA RODD GRAVESITE
CONSERVATION

This report documents the condition of the historic 1831 gravesite of Eliza Rodd, and details possible conservation actions and repairs.

The focus is on conservation: the possibilities laid out-- and the suggestions made-- all centre on preserving the historic materials, context, and meaning.

Three aspects of the monument will be discussed: the headstone, the footstone, and the site.

This report is based on on-site investigation on January 25th 2007, photographic evidence from the pamphlet *Historic Glenroy, Cox's River*, and information from Marcia Osterberg-Olsen.

<<The photograph on the left shows the gravesite at a much earlier date. Note that the inscription has been partially painted in.

HEADSTONE - SYNOPSIS
The headstone is lying face up on the ground, near its historic position. The sandstone is in remarkably good condition and should last for centuries if maintained. Reinstallation in an upright postion should be completed as soon as possible, but should prove relatively easy and inexpensive.

FOOTSTONE - SYNOPSIS
The footstone is broken into three pieces: with the lowest section still installed in its original position, but the top pieces fallen & shifted. Damage could have been from cattle, a vehicle, or a falling object at some point. The stone is, however, repairable and the inscription remains clearly legible (and will become significantly more so when cleaned and maintained). Conservation repairs will be somewhat time consuming and complex, but should improve the longevity of the marker considerably.

SITE - SYNOPSIS
The grave is located on a hillside in a picturesque valley. A single monument amidst a beautiful and historic landscape, the site is a significant place which should be preserved. Fencing the gravestones to protect them from further damage may be necessary, but should be completed with respect for the location and its meaning.

HEADSTONE

The headstone is constructed from a single piece of sandstone which has weathered remarkably well-- especially given that it fell over at some point and has been lying face-up for a considerable time. Although significantly weathered, the stone appears to be solid and stable: with large crystals (likely quartz) held in place by a strong binder which has resisted years of exposure.

ORIGINAL INSTALLATION

The original design appears likely to have involved direct installation into the ground. This was a frequent method of installation for historic marble slabs-- particularly where resources are limited. (In Guelph, settled at a similar date to the interior of NSW, this type of installation was common during the early settlement period of 1827-1867, being superceded by insertion of slabs into slots in carved limestone bases.) This type of direct installation usually followed a 1/3rd-to-2/3rds rule; with 1/3rd of the slab installed underground, and 2/3rds above. This provided reasonable stability while minimizing the extra expense of additional stone. The historic photograph of the Eliza Rodd monument appears to show this: with the slab installed to a depth just above the lowest line of writing [note that only the upper half of the inscription is painted in the photo: so it falsely appears to have a blank area]. Having the lowest line of writing just above ground level would not be consistent with an in-base slotted design, as the base would have had to either sunken into the ground deeply or have an unreasonably and uncharacteristically deep slot. A prodding test of the ground in possible original site areas (ie 1m to 2m from the footstone) did not reveal any sunken bases (though it might be possible that one was or had been there-- only sunken further than the 30cm tested)[Deeper testing was not attempted as it was decided that it was important to maintain the subsoil in a pristine condition in case any future ground-penetrating radar or similar testing is ever conducted.]

SUGGESTED REPAIR ACTIONS

1) Gentle hand-cleaning. Biological growths are natural on exposed stone, and generally cause neglible long-term damage. In this case, however, the stone was becoming completely covered over and almost unreadable-- which was affecting its historic value: the inscription is an important part of the surviving significance of this monument. Cleaning should be accomplished with soft natural- or plastic-bristle brushes and clean water. The stone should be pre-wet and then gently but thoroughly scrubbed: with released materials washed off frequently. It is important that the stone not be allowed to dry during the cleaning process. The use of biocides, cleansers, bleach and/or acids is highly discouraged: it is not necessary and could endanger the long-term viability of the stone. [The only treatment which might prove reasonably useful would be a PH-balanced biocide such as the Algicide produced by Keim in Germany. But the reinstallation of the stone in an upright position is much more important and will have a much greater impact in reducing biological growths.] Allowing moderate natural biological growths is consistent with the conservation principle of respecting the history of the stone: it is an old piece of stone installed outside... and there is nothing wrong with it appearing to be such....

January 25th, 2007: An initial cleaning was accomplished by Sach Killam and Marcia Osterburg-Olson. When the stone is reinstalled, a final cleaning should be completed (which can include the back and sides of the stone at that time). The rate of natural biological regrowth will be very much reduced by a vertical re-installation, and so should not pose any further problems for decades.

2) Re-installation: Upright In Original Position. The most appropriate re-installation technique on conservation grounds would be to replicate the original technique: installing the slab into the ground to a depth just below the lowest line of the inscription. This should provide reasonable stability, and is consistent with the last known design. The presence of flat pieces of granite in the area may indicate that the slab was somewhat stabilized by placement of flat pieces of granite around the underground surfaces of the slab. Such a re-installation should not create any new problems as long as the chunks are not too large, so might be justified.

See *Levelling Technique Report* (In the Old Chinese area of 1st General, Rookwood Necropolis, attached) for an illustrated description of similar installations and maintenance.

2.1 The headstone site should be excavated to the desired depth, with no loosening of the subsoil below the re-installation point [note that this would be different if there was a deep topsoil or clay layer in the area-- as these would require a deeper excavation and re-filling].

2.2 The headstone should be gently lifted onto its side, being careful to avoid any impact with metal tools. Preferable technique is to excavate a number of handholds below the tablet, and then lift at multiple points at the same time. At no point should the tablet be held or manoeuvred from a single point: multiple contact areas will spread the internal stress on the stone, and should ensure that it does not crack during re-installation.

2.3 The headstone should then be moved into position and lowered by gently sliding into the prepared hole: a thick cardboard should be used-- it moves along the ground well and, as long as it is clean, should not damage the stone or create scratches. Alternately, a full lifting mechanism could be used: with the specification made very clear that the tablet is never to be lifted while in a horizontal position (ie as it is while lying on the ground, and even as it would be if lying on its side).

2.4 The headstone should be held in place while the surrounding hole is back-filled. The fill material must have good drainage and should not contain any contaminants. The fill should also be compactable, creating a stable and solid matrix for holding the tablet in place. Additionally, it would be advantageous if the fill material acts to discourage potential problems such as ants and tree roots. Crushed limestone screenings may be the best fill for this purpose: it drains well, compacts into a very stable matrix, and is a natural deterent to ants and tree roots. The limestone should not contain large chunks (over 10cm in any dimension), but must be well-graded with a wide range of grain sizes. The only possible drawback with limestone would be in the unlikely case that the sandstone is mainly bound together with a clay binder. In such circumstances, lime from the limestone can enter into solution and take up spaces in the sandstone and then create differential weathering effects in the stone. The sandstone of the Eliza Rodd monument, however, has held up to weathering in an exposed location for over 150 years: it is almost impossible that a clay-bound sandstone could withstand exposure for such a long period. Alternatively, the installation could be filled using the local soil which appears to be a poorly-graded granite sand. This will provide good drainage and will not introduce any new contaminants, but does not produce a highly compacted stable substrate, and will not discourage ant colonization (witness the large number of ant colonies on the hillside). The use of large flat chunks of the native granite could help overcome the stability issues, but will not create an equivalent stability to the limestone screenings. Caution will be required to ensure that a measure of flexibility is retained in the installation: if exposed to extreme force, it is better that the installation gives and monument falls over than that the tablet snaps or shatters.

Alternative Techniques. Re-installation into a base or a concrete foundation might be suggested on stability grounds, but would produce potentially damaging situations. In the case of a slotted base, the slab would be vulnerable to two issues: it would be overly stable, and, it could be subject to damage from accelerated weathering in or near the area secured in the base. The Eliza Rodd monument definitely did fall over at some point: but the very fact that it is still complete and unbroken attests to the advantage of some flexibility in the installation. Despite whatever forces led to the tablet falling, it did not break: the installation was weaker than the stone. Limestone screenings and/or granite sand should both be weaker than the stone. A base or concrete foundation would be stronger than the stone and could lead to catastrophic failure. Furthermore, it is vital that the historic stone is not subject to soluble salts from Portland Cement: this precludes reinstallation in concrete, and would require a lime mortar if installation was into a base. The cost and complexity of such a re-installation could probably not be justified [see the Footstone section for more information on lime mortar work]. Re-installation with pins and/or epoxy should also be avoided both for stability reasons and the potential for long-term damage from impeded water movement (epoxy) or rust contaminants (steel- even stainless with eventually corrode).

FOOTSTONE

The inscribed footmarker for Eliza Rodd is broken but repairable. The historic sandstone is viable and can be preserved through a conservation hidden-pin repair.

ORIGINAL INSTALLATION

The bottom piece of the footstone appears to be intact in its original position and installation. The two upper pieces fit perfectly onto the existing bottom, and sit at a level consistent with the historic photograph of the stone. The installation matches the siting and landscape that can be seen in the original position. It would seem impossibly unlikely that the location has been altered from that of the photograph: as this would require that the bottom footstone section would have to have been somehow excavated and then reinstalled again perfectly.

The footstone was likely already broken in two pieces at the time of the photograph as can be seen from a dark line at the point corresponding to the current lower break. The presence of a deep and heavily established series of lichens all over the lower break surfaces (but not the vertical upper break) is consistent with this suggestion. The chunks of native granite in the foreground of the historic photo are thus probably a later addition to the design: an attempt to keep the footstone vertically in place. Excavating around the intact bottom piece revealed that it is stable as-is, and is held by a combination of granite sand and buried chunks of granite.

Piece 1: at front

Pieces 2 and 3

SUGGESTED REPAIR ACTIONS

1) Gentle hand-cleaning. Biological growths are natural on exposed stone, and generally cause neglible long-term damage. In this case, however, the stone was becoming completely covered over and the inscription was almost unreadable-- which was affecting its historic value: the inscription is an important part of the surviving significance of this monument. Cleaning should be accomplished with soft natural- or plastic-bristle brushes and clean water. The stone should be pre-wet and then gently but thoroughly scrubbed: with released materials washed off frequently. It is important that the stone not be allowed to dry during the cleaning process. The use of biocides, cleansers, bleach and/or acids is highly discouraged: they are not necessary and could endanger the long-term viability of the stone. [The only treatment which might prove reasonably useful would be a PH-balanced biocide such as the Algicide produced by Keim in Germany. But the reinstallation of the stone in an upright position is much more important and will have a much greater impact in reducing biological growths.] Allowing moderate natural biological growths is consistent with the conservation principle of respecting the history of the stone: it is an old piece of stone installed outside... and there is nothing wrong with it appearing to be such....

January 2007: An initial cleaning was accomplished by Sach Killam and Marcia Osterberg-Olsen. In order to complete the hidden-pin and mortar repair, it will be necessary to complete a comprehensive final cleaning of the break surfaces. The remaining parts of the stone could then also be cleaned, although the effect will be primarily cosmetic. The rate of natural biological regrowth will be very much reduced by a vertical re-installation, and so should not pose any further problems for many years.

2) Hidden Pin Repair with Sympathetic Mortar

Repair Sequence

2.1) Hand Clean. Gently but thoroughly clean all broken surfaces removing biological growths (see description above). A small amount of friable stone material may flake off.

2.2) Measure for Pins. Using a pencil, mark lines for the installation of 3 pins for each of the two breaks. The pins will be installed in an off-set formation. Eventual holes should not be closer than 1.5cm (5/8th") from any surface or edge, so the preferred layout would be for the drill mark to be set at 1.8cm (3/4th") from the edge on the thin sides. Along the break, the pins should be evenly spaced, but tending towards the centre. Note that the holes must be set up such that the pins do not cross inside the stone: particularly front-and-front pins or back-and-back ones... as they may interfer with each other. For a very small monument such as the footstone, the pins will generally need to be 5cm (2") long on each side: ie with a total length of approximately 10cm (4"). See pinning examples on the following page:

2.3) Drill. Drill the monument at the measured places. Secure the stone before drilling: preferably in a position such that it is easy to monitor the straightness of the drill relative to the thin dimension of the slab. A high-speed drill should be used with masonry bits, but under no circumstances should a hammer setting be used. Hammer-drilling historic stone will create micro-cracks in the binder matrix which may not be visible initially, but will be vulnerable to accelerated weathering damage and will lead to the destruction of the stone. Drill bits can be sharpened to a higher degree and angle than is typical for masonry bits: they will then cut much more effectively. It is vital, however, that the sharpening be perfectly even as, otherwise, the bit will vibrate in the hole and can/will cause micro-cracking. Excessive pressure is not required: the drill should be allowed to do the work in its own time. It is generally preferable to begin the drilling with a small bit, and then slowly increase the size. Even better is the use of multiple drills such that bits can be allowed to alternately drill then cool off, and smaller bits are not exposed to the full length of the drilling without a widened hole at the top. The eventual pins should be approximately 4.5mm (3/16th") in diameter, and the drill holes slightly larger at 6mm (1/4th"). Confirm the correct location of the first set of holes and pins before starting to drill the reverse set.

2.4) Measure and Check Pins. Clean out the drill holes with flowing water and repeated insertion of threaded rods. (Forced air from a compressor can be too strong for the stone and create damage. Forced air from a football hand-pump can be quite effective, but is not a thorough as water.) Measure for the hidden pins: the sum of both drilled holes minus 4mm (1/8th") is usually sufficient. The pins would ideally be composed of Phosphur Bronze and be slightly smaller than the drilled holes: approximately 4.5mm (3/16th") diameter for drill holes of 6mm (1/4th"). Marine-Grade Stainless Steel might be considered an acceptable substitute but will likely eventually introduce rust contamination and likely cause damage from chemical deterioration and through rust jacking (expansion of the iron in the steel, which will crack the stone). Marine-grade Stainless Steel is also known as AISI Type 316 and includes 17% Chromium, 12% Nickel, and 2-3% Molybdenum). Dry-fit each pin individually to check that it sits in place perfectly WITHOUT ANY PRESSURE. It is vital that the pins do not exert pressure on the stone, as this will inevitably lead to either stone failure, pin failure, or cracking in the repair joint. Once each pin is confirmed, then dry-fit all pins across one break, then the other, and then position the entire stone together. Again, no pins should require any pressure in their fit. If any hole is found to require additional work, it can be either drilled or worked until it fits. Working the hole is preferrable: using a stainless steel rod, pull it up and down on the side of the hole which must be expanded. This will gently saw at the side of the hole and widen it. Re-clean the hole and then re-test the pin. If necessary, instead, one or both holes can be expanded by drilling with a slightly larger bit. Note that if pin placements were incorrectly measured, it is not acceptable to create massive holes in the stone: re-measure (and triple-check) and then drill in a different position.

2.5) Attach Pieces 2 & 3 Together. Install pins with epoxy in the holes but NOT over the break surfaces. The continuation of the natural pattern of water movement through the stone is vital: the use of an epoxy, cement, or other impermeable adhesive in the joint will interrupt water movement and lead to accelerated damage in the adjoining stone: the stone will disintegrate at that point and the repair will fail. [See Historic Scotland 2003, Anson-Cartwright 2003 p12, and Feildan 2003 p31 for discussions of the importance of a repair/mortar being weaker and more porous than the stone it is installed in.] Instead, break surfaces should be sealed with a lime mortar after pinning, or with a lime mortar both during AND after pinning. Two techniques for pin installation follow:

2.5a) Two-step Pin Installation. The pins along one side of the break are pinned and then allowed to set. After a curing period, the second side is completed. Two-step pin installation is preferable, if time and resources allow, as it can ensure a full epoxy job (especially important if the epoxy has a low viscosity-- or develops a low viscosity in the setting process). Further instructions: the pins and holes must be cleaned and fully dried before use; a gel epoxy with a moderate viscosity and a long working time is preferable; epoxy should be placed deeply into the holes prior to inserting the pin-- a lentula device can be used with hand-turning or a low-speed drill to move the epoxy into place; holes should be half-filled before inserting the pin and have no air pockets (ie the deep half has epoxy, the upper/outer half may have a slight coating but no accumulations); pins should be coated with epoxy and then inserted carefully; no epoxy should come into contact with visible surfaces; a small amount of epoxy will be inevitable around the mouth of the hole-- but excess material should be carefully removed as quickly as possible and before it bleeds into the stone and/or sets. In order to ensure that the pins are installed at the correct orientation, it is often valuable to brace the initial pinning side upright and then have the epoxy set with the pins in position. Note that there must be NO excess epoxy in or around the pins and joint as, otherwise, the pieces can be inadvertantly bonded together. Similarly, the pins can cause a serious problem if they are not parallel (or, at least, very close to parallel.) as they will hold the un-epoxied second side in place accidentally. Obviously, the pinning process requires patience, experience, and thoughtful care. Once the first side has set (and it is best to allow the epoxy to reach a near-full strength-- often 24 hours or so), the pins can be checked against the holes on the opposite side. Any holes which require reaming can then be enlarged (see 2.4). The second side of the pins can then be completed using the same technique but with the addition of clamps to hold everything in place during the setting process. Caution must be used to ensure that the clamps are as tight as possible WITHOUT causing any stress to the stone OR deformation OR slippage-- the latter can be quite tricky and may involve the use of angled shims.

2.5b) One-step Pin Installation. This repair is completed as per 2.5a, but both sets of pins are installed at the same time. This introduces a number of potential complications with the epoxy and the timing. Firstly, the epoxy may flow partially or fully out of the upper hole during setting. This can produce weakness or failure of the pin. It can also lead to air pockets in the seal around the pin, increasing its vulnerability to weathering. Secondly, attempting to complete both sides of a pinning job at the same time can lead to difficulties with premature setting of the epoxy. Inserting the epoxy inside the drill holes can be a time-consuming job, and ensuring a perfectly aligned setting of the two stone pieces can also take a considerable time. Attempting to set both pins simultaneously requires the practitioner to accomplish twice as much work in the same amount of working time as would be available for completing a single set/side of pins. Clamping is vital for one-step pin installation but must be completed with caution (see the warnings in 2.5a).

In both cases, if the open break joint is perfectly tight, it can be treated with neat Natural Hydraulic Lime during the pin-setting process. Lime mortar would still be used on any open and accessible joint areas: but, especially with the break between pieces 2 & 3, the space between the stone may be too small to access effectively. Similarly, mortar can be placed in the joint during the final pin-setting, but this is very difficult to complete correctly: as any excess mortar in ANY place within the break with compromise the repair. [These techniques are thus suitable only when highly experienced practitioners are completing the repair. Note also that a two-stage pinning process is also recommended for each repair if the open joint is being treated, as it reduces the complexity of the latter part of the setting.]

Photographs: Two-Step installation; Repair ready for plying; and, Applying neat NHL to the repair in process

2.6) Attach the joined pieces 2&3 to the extant lower piece 1. Follow the above instructions (2.4 & 2.5) to complete the re-installation.

2.7) Lime Mortar. Once all of the pins have set (refer to information from the epoxy supplier: usually 24 hours), the monument should be gently tested. There should be no noticable movement under reasonable pressure. If the pinning work has been successful, the joints can then be repaired with a lime mortar using no portland cement (neither white nor grey). A full discussion of the techniques and advantages of lime mortars is beyond the scope of this report (See References for more complete information), but key points include that, if properly prepared, the mortar will be slightly softer, more flexible, and slightly more porous than the stone. This will help to ensure that future damage occurs in the mortar and not in the historic gravemarker. The lime mortar should also be self-healing if minor cracks develop. All of these properties, however, depend on the correct preparation, installation, and aftercare of the lime mortar. At Woodlawn, a 1:1:5 mix is generally used for similar monuments: 1 part lime putty, 1 part Natural Hydraulic Lime, and 5 parts aggregate (a well-graded mix ranging from microfine stonedust to fine (seived) or medium sand: angular and sharp). As an alternative, a mortar could be prepared from lime putty gauged with a pozzolan: in a 2:1:7 or 3:1:9 proportion (lime putty, pozzolan, aggregate) with a similar sharp and well-graded sand. If Natural Hydraulic Lime is not available, the gauged pozzolan mix might be the only option. Westox is an Australian supplier for both lime putty and for a premixed coarse stuff (lime putty with sand) accompanied by a pozzolan. [I have not yet tested their products, but they appear to have a thorough knowledge of lime and lime products.] Preparation of the mortar is through a combination of beating, chopping, and kneading: it is not simply a mixing process (like cement). The lime must be crushed into the smallest available spaces. No water should be added to the mortar: it will emerge during the beating and kneading (from inside the lime putty and the NHL, prepared as per its instructions, if applicable. In dry and windy conditions, it may be necessary to add a few spritzes of water from an atomizer to replace evaporated water. The mortar will be slightly crumbly but hold on to a knife if pressed in and lifted out. Application of the mortar must be to a clean surfaces which have been thoroughly pre-dampened (though without any standing or pooling water). The mortar should be firmly placed into joints using as small a tool as necessary (strong forks which have been ground down to a single tine can make good applicators). The mortar must not be allowed to dry out while the job is being completed: protect it from direct sunlight and spritz with water regularly as necessary-- or cover completed areas with damp burlap (hessian). When the mortar is completely in place, the surface should be finished by pounding it with a strong short-bristle brush. Lime mortar should not be smoothed: it must have a rough and open surface to function properly.

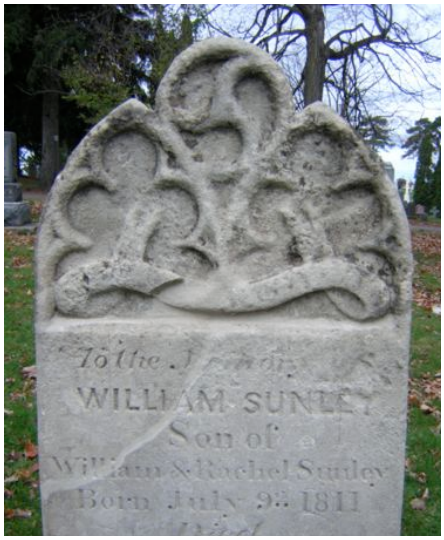
Hydrated lime (also known as ‘builders lime’) is not a substitute for either lime putty or Natural Hydraulic Lime. Portland Cement (grey or white ‘federal’) is not suitable for conservation work: it creates a mortar with a dense, impermeable, rigid, and overly strong structure which will endanger the historic monument and will also release soluble salts which can catalyze the deterioration of the stone. Mixed with hydrated lime, the cement will be less durable, but similarly damaging to the historic fabric: with weathering concentrating in the stone surrounding the cement mortar, instead of the mortar itself.

A lime putty mortar joint for a hidden-pin repair (Repair 1999, Photo 2005).

2.8) Aftercare. The aftercare will be particularly important in the case of the Eliza Rodd gravestone as the dry and exposed conditions could easily lead to premature drying of the mortar before carbonation occurs. The stone, which will have been thoroughly pre-wetted before the mortar installation, will have to be kept moist (but without any pooling water) for a period of at least one week. The stone should be allowed to dry from the inside out, at a slow and steady rate. Damp burlap (Hessian) should be applied over the footstone and around the repair areas. The entire monument should then be draped with plastic to retard the rate of air-drying. Light coloured plastic is preferable to dark as it will reflect light instead of absorbing heat. At Woodlawn, a double layer of plastic is used: a transparent bag first, then a light orange or white bag as an upper layer. Plastic can be secured with rocks or twine but should not be taped too tightly to the stone as it is important that there is no risk of the setting mortar being starved for carbon dioxide. The monument should be checked regularly as it is setting to assess the rate of drying and ensure that it is slow. If necessary, the burlap should be sprayed down with an atomizer (hand water nozzle) to re-dampen it.

Aftercare examples

Completed hidden-pin repair

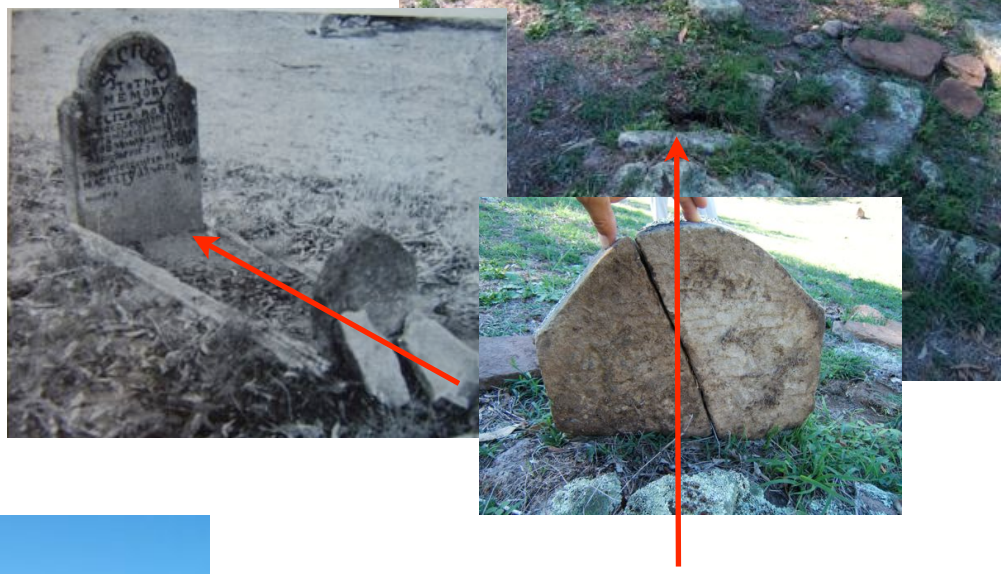


SITE

The grave is located on a hillside in a picturesque valley. A single monument amidst a beautiful and historic landscape, the site is a significant place which should be preserved. Fencing the gravestones to protect them from further damage may be necessary, but should be completed with respect for the location and its meaning.

ORIGINAL INSTALLATION

A comparison of the current location of the intact in-ground footstone piece with the apparent background of the historic photograph seems to show that the footstone is indeed in its original location. It would be almost impossible for the surviving in-ground footstone fragment to have shifted and then somehow been reburied to just the right height and orientation by accident. It might be possible, however, that the memorial was moved or reinstalled in an incorrect location at some point prior to the historic photo. That the current site is the correct one, however, is a reasonable conclusion on the basis of the available evidence. Further research could be undertaken with ground-penetrating radar or a similar technology if necessary.



Comparison: The end of the right arrow is the base of the footstone. The angle corresponds with that drawn over the historic photograph: with the ground falling away at a significant but gentle slope to the right and ahead.

SUGGESTED REPAIR ACTIONS

The immediate priority for the preservation of the Eliza Rodd gravesite is to protect it from damage from cattle and vehicles. A solid fence thus seems necessary, although it will be very important to ensure that the fencing does not overly detract from the historic appearance of the site. The grave is currently integrated within the landscape, and part of its historic meaning stems for the direct inclusion of the grave within the surrounding area. On the other hand, especially once repaired and reinstalled, the stones will be vulnerable to damage: they must be protected from cattle rubbing against them, and should also be protected from vehicles. [Fencing is not a problem which I am very familiar with, so I will make no specifications except that the fencing should be both functional and sympathetic to the historic design and landscape.]

CONCLUSIONS

The Eliza Rodd gravesite is an important historic place which should be conserved as soon as possible. The priority must be in protecting the site from further damage. Once the area has been secured, the headstone can be reinstalled. The footstone fragments can be laid out close to their correct location (ie beside the remaining in-ground piece) and then repaired as soon as time and resources allow. With the exception of the footstone repair, the required conservation work is relatively easy and should be inexpensive, though it will require patient and cautious attention and care.

REFERENCES AND FURTHER RESOURCES

Tamara Anson-Cartwright, *Landscapes of Memories: Repairing Tombstones: A Guide for Conserving Historic Cemeteries*, Queen's Printer, Province of Ontario, Canada, 2003. [ISBN 0-7778-7260-9] Available through Ontario Publications: see http://www.culture.gov.on.ca/english/culdiv/heritage/memories.htm

Historic Scotland and The Scottish Lime Centre, *Technical Advice Note 1: Preparation and Use of Lime Mortars*, Historic Scotland Technical Conservation, Research and Education Division , Edinburgh, Scotland, 2003 [ISBN 1 903570 42 5] Available through Historic Scotland, see http://www.historic-scotland.gov.uk/index/shop/product_detail.htm?productid=594

Bernard Feilden, *Conservation of Historic Buildings*, Architectural Press Elsevier, Oxford, 2003 [ISBN 0 7506 5863 0] Available through the publisher at http://textbooks.elsevier.com/web/product_details.aspx?isbn=9780750658638

ONLINE RESOURCES:

Scottish Lime Centre at http://www.scotlime.org/

Virginia Limeworks at http://www.virginialimeworks.com/mainindex.htm

St. Astier lime information at http://www.stastier.co.uk/test.htm

The techniques discussed in this report as based on the practice and experience of maintaining and repairing hundreds of monuments at Woodlawn Cemetery based on conservation training over the past 10 years from Tamara Anson-Cartwright and Master Stonemason Per Neumeyer, and with additional information from an advanced lime mortar course at The Scottish Lime Centre.

The Woodlawn Historic Monument Care website has information on the rationale for our programme as well as linking to photo galleries of repairs. See: http://guelpharts.ca/woodlawncemetery/section.php?sid=40