JANUARY 21, 2011

City of Lethbridge Cemetery Master Plan

CITY OF Lethbridge

LEES+Associates Landscape Architects

with:
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Land Economists
and
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City of Lethbridge

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Cemetery Services Mission Statement:

Cemetery Services preserves the record of those that have been interred in our community and provides an appropriate atmosphere for interment services and commemoration.

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Executive Summary

Since 1994, a series of studies have indicated that there is a growing need for new cemetery space to serve the community over the long term. In 2006, the report by LEES+Associates, “Cemeteries Development and Management Plan,” identified two key goals:

- Acquisition and development of a new cemetery site of approximately 38 ha (95 acres) to meet the needs of the community for the next 100 years, and
- Improvements to the sustainability and future cost recovery basis of the business unit.

In 2009, the City of Lethbridge secured a 90 acre/36.26 ha proposed cemetery site located at 5310 13th Street North. In early 2010, the City commissioned this City of Lethbridge Cemetery Master Plan, with the following two objectives:

1. To undertake a spatial needs analysis and assessment to determine the community’s interment needs. This was intended to identify how to best meet future needs, based on population and interment projections and existing resources; and

2. To develop a physical plan for the development of the new cemetery site. This plan would have the capacity to be constructed in phases, with the first phase providing approximately 20 years of interment capacity.

A business model and financial case for the Cemetery Services business unit was also commissioned, with the intent that it would provide the framework for the desired level of cemetery operations and management. This work was undertaken simultaneously but separately from the spatial needs study and physical plan, and has been printed under separate cover.

Spatial Needs Analysis and Assessment

The capacity provided by the existing City cemeteries was reviewed to identify opportunities to achieve additional interment space. The results were depicted on plans of the two active cemetery sites, Mountain View and Archmount. St Patrick's cemetery, which is closed to sales, was reviewed in light of possible niche capacity only.

Opportunities were identified to infill lots in underused areas and to convert space designated for one type of use to another more desirable use. Potential new interment capacity was identified by type (casket lots, cremation lots and columbaria). The results of this process were:

Mountain View Cemetery:
If all areas were developed as depicted on the plans, Mountain View could accommodate approximately 1,550 additional casket lots. At a rate of 250 sales per year, this would add up to about six years of new casket lot capacity to the system. Where casket lots would not be possible, available space would accommodate approximately 900 niches. At the current rate of +30 niche interments per year, this represents approximately 30 years worth of new niche capacity.

It should be noted that the long term role of Mountain View should be to provide for at-need interments only and to concentrate on offering a range of cremation interment options. Its focus should be to serve families with existing ties to this site.

Archmount Cemetery:
The primary recommendation is that the undeveloped area at Archmount be sold or returned to the City Reserve. The extent of undeveloped land at Archmount is far beyond what could ever be successfully developed and marketed as an attractive place of interment at this location. This cemetery is increasingly compromised by surrounding commercial and industrial zoning and development, including that proposed in the recent West Lethbridge Employment Centre Area Structure Plan.

Based on the history, perception and on-going challenges of operating a cemetery at this location, it is recommended that Archmount be maintained to an appropriate level, but that plans to invest in its expansion be abandoned. It is recommended that Cemetery Services divest of Archmount's 15 undeveloped acres and use a portion of the revenue to make improvements to the existing developed area. This will ensure that the current inventory of approximately 1,600 single depth casket lots (over 100 years of capacity at the current rate of sales) can be marketed and maintained more effectively than is currently possible.

Capital investment is required to bring the functionality and aesthetics of the site up to a level comparable with other City cemeteries. On-going drainage issues are the priority, along with the restoration and upgrading of many of the site's original design features and elements. The upright monuments now preferred by most cemetery customers are not possible at Archmount; however, cremation interment options should be added to provide Archmount families with the same options as offered at Mountain View. Investment should be made in the following areas to overcome the cemetery's limitations and to increase sales to a reasonable level.

1. Drainage infrastructure,
2. Upgrading of basic site features and aesthetics, and
3. Incorporation of cremation interment options.

The long term role of Archmount should be to serve residents of West Lethbridge and families with existing ties to this site.

St Patrick's Cemetery:
It was determined that even as a closed "Pioneer Cemetery," St Patrick's could accommodate niches in small columbaria distributed throughout the site. The property is located in an area subject to change in the forseeable future, at which time the quality and desirability of the cemetery will likely improve. In the meantime, the focus of this site should be on serving the community primarily as a park and heritage resource.

Other improvements should include signage and landscape enhancements.

There are capital costs associated with achieving increased capacity at the existing sites, and such investments can only forestall the need to construct a new cemetery site. Non tax-based funding options are available to undertake discrete projects at Mountain View and Archmount. Such initiatives could enhance their capacity and place within the system but should not defer the development of the new cemetery site, for which funding has already been secured.

Green Burial in Lethbridge

The opportunity exists for the City of Lethbridge to consider expanding interment options at its existing and new cemetery sites to include “green burial” (also known as “natural burial” or “country burial”). The defining characteristics of this type of interment include:

- No embalming;
- Burial directly in the ground;
- No use of grave liners or vaults;
- A fully biodegradable burial container (casket or shroud);
- Interment sites planted with only indigenous groundcover, and
- No individual grave markers.

While green burial is still relatively rare in Canada, interest in this option is growing. Offering this form of interment would not require any additional infrastructure (or the use of irrigation). It has the potential to increase capacity at Mountain View by designating green burial areas in the small, unusable “fingers” of land along the top of bank at the coulee edges. An area suitable for this type of interment has also been identified at the new cemetery site.

Cemetery System - Levels of Service

City of Lethbridge residents have expressed high expectations for cemetery maintenance and aesthetics. Cemetery Services has responded by maintaining a high standard of operations, service and maintenance, particularly relative to many other comparably-sized municipal facilities. Cemetery Services has made arrangements with Parks, Pathways and Trails to take advantage of available in-house resources and expertise; however, cemetery maintenance is labour intensive due to the large number of graves, headstones and special features.

The attractive cemetery environment comes at a cost. Where these costs should be within the spectrum of municipal services is subject to discussion over time. Proposals to reduce standards at cemeteries can elicit strong public response due to the unique historic and cultural role of cemeteries within the community. It should be borne in mind that allowing maintenance-sensitive features such as trees and monuments to decline due to reductions in maintenance can make it very difficult to restore them, should priorities change in the future.

The New Cemetery: Conceptual Site Plan

The cemetery site straddles Pavan Park Drive, the access road that extends east from 13th Street North through a narrow coulee to Pavan Park. The open and relatively level character of this site presents no obstacles to creating an efficient layout throughout the development area.

A Phase I Environmental Site Assessment of the project area has been completed, as well as Geotechnical Evaluations of slope stability, subsurface soil and groundwater levels. The field work for Historical Resources Impact Assessments (HRIA) has also been completed and submitted for provincial approval.

The concept plan developed for the new site is provided on the following page:

Figure i

Lethbridge Future Cemetery Concept

LEES+Associates Landscape Architects

During the development of the conceptual plan, it was calculated that the cemetery would need 4,300 burial lots and 7,609 cremation lots to serve the community for the initial 20 years, 2012 – 2032. This represents an interment area of 2.77 ha.

Once the roadways, entry and perimeter buffer areas were included, the area required for Phase I development totaled 3.77 ha. This figure was used in calculating the new site's Phase I development cost estimates.

Since the new cemetery was to be planned as a single unit, a central location was required for vehicle access. A point of access from Pavan Park Drive was chosen, primarily to strengthen the connection between the two parts of the site. A north-south axial entry road is planned to lead to a future cemetery office building located in the larger, north section. Detailed design should focus on accommodating the future conditions at this intersection, possibly incorporating traffic calming features. Possible secondary points of entry/egress should be considered at the detailed design stage.

At the conceptual level, site access by pedestrians would be from along the roadways except where linkages with trails are desired. Connections should be planned between the cemetery and the existing trail system developed by Lethbridge Parks Department Operations. Site fencing could include a visually unobtrusive wire fence (a more attractive alternative to traditional chain link), which would minimize encroachment by wildlife while maintaining views to the coulees.

All development indicated on the concept plan is within the development setback line, in accordance with City of Lethbridge By-Law # 5277. The following development guidelines have been considered in the preliminary concept and should be incorporated in the detailed design phases:

- Restrictions on irrigation within the restricted development zones,
- Restrictions relating to earthworks and ground disturbance, and
- Providing EBA the opportunity for further review prior to construction.

Three high voltage Altalink power lines traverse the cemetery site. Altalink requires that a site plan be submitted for review at the detailed design stage to ensure that their height restrictions and equipment clearance setbacks requirements are met. The concept plan proposes a significant evergreen tree buffer along the east side of the power corridor. Some land forming may also be considered to further mitigate the prominence of the towers, although any grading adjacent to the top of bank should be reviewed to make sure that it will not impact slope stability.

The concept plan proposes to maintain the current general drainage pattern including the current drainage of stormwater runoff from east of 13th, down Pavan Park Drive. A system of ponds are proposed along the Pavan Park Road as entry features and to control stormwater runoff from the site. The ponds could also serve as a source of water for irrigation within the cemetery, supplemented by water delivered through the potable water distribution system or SMRID irrigation system. Low Impact Development (L.I.D.) techniques can be used to mitigate the increased storm runoff from the site and promote water quality improvements. Consideration must be given to the design of ponds to ensure that they do not influence groundwater levels and affect the active working depth of the lots.

To minimize the initial and replacement cost of infrastructure, a minimal amount of storm drainage piping would be provided.

Similar to other parks in the City, an overland drainage system could convey the majority of stormwater runoff to the outlets from the site. Site grading will follow the existing ground topography as closely as practical while creating positive drainage to the ponds. Piped storm drainage piping would be utilized only where proper drainage cannot be achieved through surface grading.

The ultimate outlet for the largest portion of the stormwater runoff from the site will be the Pavan Park Road. Stormwater detained in any on-site ponds could be released to a trunk storm sewer that will be constructed to serve future development via outlet structures constructed for the ponds. Runoff from other areas of the site will continue to drain over the edge of the coulee slope. Care must be taken to ensure that drainage released over the coulee edge is not concentrated to specific points of discharge.

Cemetery aesthetics are a vital consideration in the success of the facility, and much of the design for aesthetic features will take place during the detailed design phase. Overcoming the relatively remote location, the visual impact of the power transmission lines and the absence of trees or other existing natural features at the new site will require an investment in developing and installing aesthetic features. The concept plan proposes extending a generous entry area landscape across the edges of Pavan Park Drive to tie the north and south sections together as well as the key aesthetic feature of the “system of ponds” flanking the intersection of Pavan Park and 13th Street North.

Entry features and signage should be designed to be visible from the site approach along 13th St. N. The character of all site walls should convey dignity and permanence and be constructed of quality materials. The design should reflect a “contextual” quality, so that the character of the walls fits and looks appropriate to its southern Alberta context.

Xeriscape species and planting techniques should be employed wherever possible, notably along the perimeter of the developed area. Glimpsed views to coulee trails and rocky overlooks should

be provided along the roadways. Subtle land forming in buffer areas can create an attractive counterpoint to the more formal landscape of the in-ground interment area.

A future administration building, which would house a reception area, offices, meeting rooms and washrooms, is indicated in the north section of the site. A 500 m2 building site is provided to accommodate a 3,000 ft2 (915 m2) building, plus pedestrian areas and landscaping. An additional 2,800 m2 is included for parking for up to 100 vehicles. The concept plan includes a site for an operations yard of approximately 1,000 m2 located to have the least visible impact, while still being relatively central.

Domestic water for the new cemetery site can be provided through connection to the recently installed Picture Butte water supply pipeline along 13th Street North. Should the City wish to pursue a non-potable water supply for irrigation purposes, an evaluation should be undertaken in consultation with the affected stakeholders.

A septic tank and absorption field would likely be adequate to treat the volume of domestic wastewater generated by the cemetery office building. Provision for the future connection to the City's central wastewater collection should be incorporated at the detailed design stage.

The concept plan was developed to the $2.8 million construction budget as approved by the capital funding program for Phase I development. Construction was projected to begin no later than 2011, with anticipated completion by 2012.

Cemetery Programming

Over the past few years, there has been a movement among North American cemeteries to expand their role from providing only interment services, to hosting and providing a venue for non-interment related events. This reflects a new trend to diversifying cemetery programming ("programming" referring to everything expected to - i.e. should and could - occur at a cemetery site.)

The City of Lethbridge also recognizes the role of cemeteries as recreational, cultural and historical resources. Cemetery Services has expressed an interest in broadening the programming that could take place at the new cemetery site.

In terms of its size and location, the new cemetery site is well-suited to becoming a future community event location, especially as Lethbridge expands north. Panoramic views over the coulee could provide a dramatic context for public art exhibits, outdoor music concerts and lectures, and a range of annual memorialisation events. Naturalist tours, bird walks, and hiking, biking and equestrian trails are highly compatible with this location. The rocky promontory in the northwest section could be carefully designed for public access and an internal pond could provide a focal point for water-related events and displays. The water features at the entry could also be designed to accommodate appropriate displays. The list of programming opportunities was prepared in a detailed Programming Brief that is included in the Appendices of the report.

Conclusion

Cemetery operations, management and infrastructure are poised to undergo a shift in how cemetery-related products and services are provided in the City. The success of the transition period will depend on the careful and systematic implementation of its recommendations, as well as continued collaboration with other City departments, cemetery customers and residents.

Cemetery Services is well positioned to proceed in a manner that will build on the current resources, and achieve the desired level of financial viability, customer service and contribution to the standard of living in Lethbridge.

1. Introduction

The City of Lethbridge operates and maintains three cemeteries under its internal business unit, Cemetery Services. This unit is responsible for ensuring the availability of interment and memorial services to all residents of Lethbridge and the greater Lethbridge community. The cemeteries that make up the City of Lethbridge cemetery system are listed below. There are no other cemeteries operating within City limits.

Site	History	Location	Size	Total Existing Capacity
St. Patrick's Cemetery	Established 1886; Acquired 1953	North Lethbridge	15 acres (fully developed)	nil (closed to sales)
Archmount Cemetery	Established 1955; Acquired 1982	West Lethbridge	33 acres (15 acres undev 'd)	1,738 lots
Mountain View Cemetery	Established 1901; Acquired 1942	South Lethbridge	69 acres (fully developed)	1,633 lots

Figure 1: Existing Cemeteries, LEES+Associates

In 2006, LEES+Associates prepared a report, “Cemeteries Development and Management Plan” for the City of Lethbridge. This study identified two key goals:

- Acquisition and development of a new cemetery site of approximately 38 ha (95 acres) to meet the needs of community for the next 100 years, and
- Improvements to the sustainability and future cost recovery basis of the business unit.

In 2009, following a site selection and evaluation process outlined in the LEES+Associates report, Cemetery Services acquired a site for the proposed new cemetery in North Lethbridge.

In January 2010, the City issued a Request for Proposals for the preparation of a Cemetery Services Master Plan, which was to have the following three key outcomes:

1. A business model for Cemetery Services;
2. A community spatial needs analysis, and
3. Conceptual maps of the existing and proposed cemetery sites indicating current and proposed land uses, based on the results of the business model and spatial needs analysis.

The Master Plan was also to include a capital budget analysis for development of the proposed site for interment use as early as mid 2012.

In March 2010, the project was awarded to the cemetery planning team of LEES+Associates, (Landscape Architects and Cemetery Planners) with G.P. Rollo Associates (Land Economists) and Stantec (Consulting Engineers). This document constitutes the comprehensive report and summarizes the work done by the consultant team in collaboration with City of Lethbridge Staff. The objective of this report is to provide Staff with a “road map” for long term, effective management of the City of Lethbridge cemetery system as a whole.

Project Objectives:

The business case analysis of the cemetery system was conducted simultaneously but separately from the development of the physical planning components as outlined in the scope of work for this project, which therefore had two key objectives:

1. To analyze the spatial requirements of the community for interment purposes. This was intended to identify how to best meet future needs, based on population and interment projections, and existing resources; and
2. To develop a physical plan and capital analysis for the new cemetery site. This was intended to provide a conceptual plan for the new site, based on the analysis of the first two steps. The plan would have the capacity to be constructed in phases with the first phase providing approximately 20 years of interment capacity.

The City of Lethbridge also recognizes the role of cemeteries as recreational, cultural and historical resources. Cemetery Services has expressed an interest in broadening the programming (activities and uses) that could take place at the new cemetery site. This interest influenced the development of both the physical plan and the business plan, which include opportunities

for expanding programming and allocating resources to gradually enrich the City's cemetery system and make its sites more relevant and accessible to the public as a whole.

Project Approach:

The approach taken for this project was first to compile and review relevant background information, including ortho photo and GIS data, provided by the City of Lethbridge. Site visits were made to the existing three cemeteries and the proposed, new cemetery site and meetings were held with key City Staff. Representatives from Cemetery Services; Community Services; and Infrastructure Services. Meetings were held with representatives from the City Manager's office and with Financial Services, who collaborated closely with the consultant team throughout the development of the business case component of the project.

The next step focussed on developing the conceptual site plan for the proposed new cemetery. The consultant team worked with Staff to develop and apply spatial and physical criteria, and to prepare the cost estimates and graphic materials required for the presentation to Council for the current, three-year Capital Improvement Program (for the years 2011-2020). This material, which fulfilled the third objective of the project, was posted for public review at City Hall and on the City of Lethbridge website.

Three options or "scenarios" for cemetery management were then developed using the Cemetery Business Case Analysis Tool©, a procedure developed by LEES+Associates for cemetery financial planning. This phase fulfilled the primary objective of the project. It also "proofed" the ability of the new cemetery to meet interment needs of the community, and confirmed financial projections for the development and operation of Phase I of the new cemetery site, through to the next round of capital investment in year 13 (the year 2028).

The spatial needs analysis phase focused on identifying the potential to increase interment capacity within the existing developed areas at Mountain View and Archmount cemeteries. Analysis began with a comprehensive area-by-area review of these sites to identify how space might be reclaimed or converted to more desirable uses. The products of this process included a concept indicating how capacity at Mountain View Cemetery could be expanded slightly and a graphic strategy to diversify and optimize capacity within the developed section at Archmount. This work fulfilled the second objective of the project.

Through the course of the work, the consultant team held weekly phone conferences with Staff. This process proved very effective for tackling a wide variety of tasks and issues. The range of issues and tasks are discussed in detail in Chapters 2, 3 and 4. Graphics and supporting information is provided in the Appendices of this report.

2. Background and Context

Brief History

The story of Lethbridge is characterized by growth, beginning with its rapid progression from the coal-mining settlement of Coalbanks (est. 1882), to the community of Lethbridge (1885), to its designation as a town (1891), and a city (1906). As in the many communities that sprang up across the Canadian west at this time, the needs of Lethbridge residents—including the need for a final resting place—was met by churches and private entrepreneurs rather than government institutions.

Four cemetery sites originally served the area that now lies within the City's municipal boundaries: St Patrick's Cemetery, Mountain View Cemetery and Archmount Cemetery (as noted in the table above), plus River Bottom Cemetery, a small burial ground that operated from 1883 to 1886 and is now a part of Indian Battle Park. (There are also several small, sectarian cemeteries in the broader Lethbridge area but they are located outside of City boundaries.)

Although none of the cemeteries within City boundaries was initially established to serve as a municipal cemetery, all were eventually assumed by the City of Lethbridge. As early as the 1890's, area residents were expressing concern regarding poor conditions at St Patrick's Cemetery. Established on property owned by a local coal mining company, St Patrick's was used by three different communities (Catholic, Protestant and Chinese) and maintained largely by the families of those buried there. Similar complaints about poor maintenance later arose regarding St Augustine's Cemetery, a site at the original centre of Mountain View, owned and operated by the Church of England. The most recently established cemetery in Lethbridge, Archmount, is unique in that it was established as a private venture; although it also suffered a decline in care as the enterprise gradually failed and was abandoned by its owners. In each case, the City of Lethbridge was charged with taking on the ownership of each cemetery—typically after already having taken on its maintenance.

The Hebrew Cemetery, established in 1909 on a one acre parcel now encompassed by Mountain View, was the final cemetery property whose maintenance was assumed by the City. In this case, an agreement was struck in 1957 for the City to maintain and operate this area (for a nominal annual fee) on behalf of the congregation.

Inadequate cemetery maintenance, operations and record-keeping were common problems throughout the early years. These issues continued to be the cause of public concern for decades until the province of Alberta imposed legislation to address the problem. The Cemeteries Act, legislation that restricts the establishment of new cemeteries anywhere in the province to religious organizations and municipalities, was enacted in 1980. It stated that “No new cemetery may be established except by a religious auxiliary, religious denomination or municipality.” (Source: Jan 1, 2007, Province of Alberta Cemeteries Act RSA 1980 cC-2 s4.) The intent is to ensure that cemeteries are maintained in a respectful manner by charging permanent institutions, rather than for-profit enterprises, with their care.

Under the Cemeteries Act, the City of Lethbridge is responsible for the management, operation and maintenance of its three cemeteries. Current legislation prohibits the disturbance or redevelopment of any place of interment anywhere in the province of Alberta, meaning that once any site is used for interment, it must be maintained as a cemetery in perpetuity. The ability of a municipality to manage interment sites to a reasonable and respectful level over the very long term requires careful financial management. In Alberta, contribution to a perpetual care fund or reserve (or similar interest-bearing account) is recommended but not mandated by law. As old public cemeteries gradually fill up, their municipal owners are becoming increasingly concerned about their ability to pay for cemetery maintenance, particularly after their sites are full and closed to revenue-generating sales. Unless the long term intent is that cemeteries will be operated as parks, the need to build a healthy care fund or reserve to cover costs over time is now understood as a critical factor in the long term financial viability

of cemetery management.

Cemetery capacity in the City of Lethbridge has not been augmented since the acquisition of Archmount Cemetery in West Lethbridge 1982. Since that time, St Patrick's Cemetery has reached capacity and has been closed to further sales. Mountain View and Archmount both remain active and continue to have interment capacity available; however, demand at Mountain View is far greater than at Archmount and the inventory of existing space at Mountain View is rapidly declining. Public perception of Archmount is that it is the least desirable cemetery in Lethbridge. Its location in an increasingly industrial context and ongoing issues with groundwater compromise this site's ability to contribute meaningfully to the overall interment capacity of the cemetery system—especially relative to its size.

The need for cemetery space to serve the community over the long term was first identified in the 1994 "Cemetery Spatial Needs Study" prepared by the City of Lethbridge. This study projected that the community's interment needs could be accommodated until at least the year 2020 through the expansion of the developed area at Archmount Cemetery.

A subsequent study, "Lethbridge Cemetery Development and Management Plan," (2000, Stantec Consulting) recommended that, even with improvements to increase the capacity at existing sites, a new cemetery site of between 75 and 160 acres should be developed and be operational within the next ten years. It also recommended changes to the pricing structure and the establishment of an interest-bearing Cemetery Reserve "for long term financial viability and self-sufficiency of the cemetery operation."

In a Council resolution of Feb 22, 2010, the City reiterated its interest in evaluating the merit of its cemetery system operating under the business model of "full cost recovery" (requiring little or no tax subsidy.) The business plan component of this project was undertaken with the mandate to explore this model, as well as scenarios that would continue to require some degree of tax subsidy.

The physical plan component of this study was undertaken to evaluate the most effective means of providing interment and memorialisation space within the system as a whole, and to a level at least comparable to current industry standards. The strategy was to plan for the new cemetery site to eventually replace Mountain View and Archmount (becoming the primary City cemetery), but to also optimize yield at these existing, developed sites. Rather than simply close the older cemeteries as they reach capacity, the approach would be to invest carefully in existing sites, prolonging their active lifespan and optimizing their capacity, while gradually shifting sales of interment space (particularly traditional, in-ground casket lots) to the new cemetery site. Once the current sites reach capacity, the new cemetery in North Lethbridge would become the only active place of interment within the City of Lethbridge.

Statistical and Demographic Analysis and Projections

As authorized by the Municipal Government Act, the City of Lethbridge conducts an annual census, which provides an accurate count for provincial and federal funding. The data shows that since the 1970s, the City of Lethbridge has been growing at a rate of over 2% per year, and has now reached a population of 86,659 (Source: 2010, City of Lethbridge Census). Census data also provides a valuable resource for tracking population and other demographic trends. The graph (left) illustrates the 2010 distribution of age groups within the City.

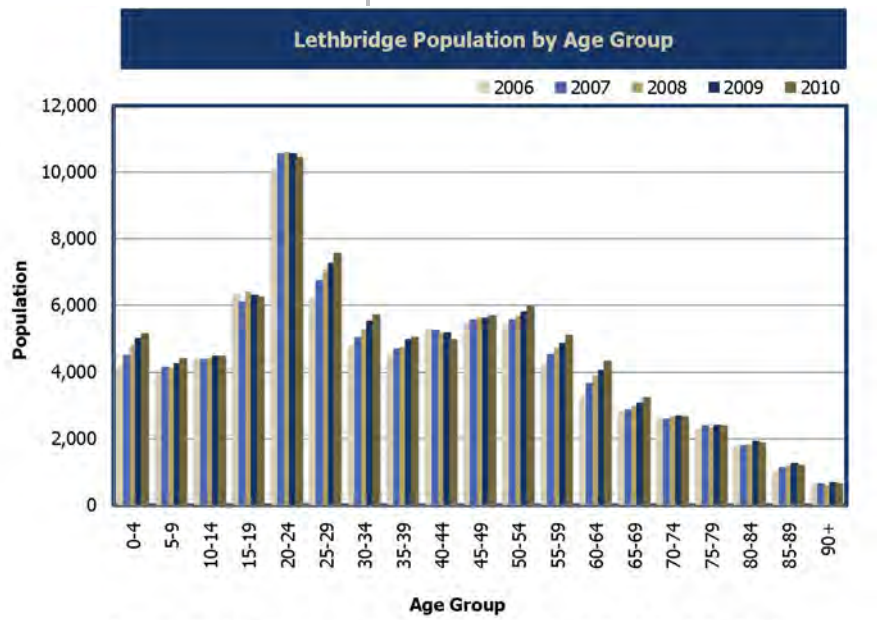


Figure 2: Lethbridge Population by Age Group, City of Lethbridge, Lethbridge Census Report 2006, 2007, 2008, 2008 and 2010, Lethbridge AB, 2010

Although this graph depicts a relatively young population (partly due to students at the University of Lethbridge and Lethbridge College), the key demographic in terms of cemeteries is the segment of the population over the age of 55. This group (part of the “Baby Boom” generation) represents a significant segment of the population whose deaths over the next few decades will constitute the bulk of the cemetery market. This group is not only beginning to experience natural losses, they are also beginning to think about their own needs after death. They are also a major influence in the more imminent end-of-life planning and interment needs of their parents. Since the population currently 55 years of age and over are the least likely to leave the City before they die, this segment should be a focus of the initial period of Cemetery Services planning in Lethbridge.

Predicting future needs is a fundamental part of cemetery planning. Good planning depends on access to reasonably accurate predictions for how much land should be developed and what types of interment products and services should be made available—and when. This is a challenging task, because preferences change and maintaining developed but unsold cemetery capacity can prove costly over time. On the other hand, consumers increasingly expect choice, and newly developed, but unsold, cemetery area can contribute to the functionality and aesthetics of the site as a whole. Diverse programming of cemetery space can also help mitigate costs, so achieving a cost-effective balance is the goal.

Projecting land needs is based on applying statistical information to future populations in a way that will yield a reliable estimate of interment area requirements over a given period of time. The following four variables are typically used to plan and develop cemetery capacity:

- **Expected Deaths:** The number of people multiplied by the statistical Average Death Rate (A.D.R.) or number of deaths per thousand over the period in question. This provides the number of deaths per year that can be expected in the subject area.

- **Interment Trends:** Types and percentages of interment choices being made within the population. This provides the percentages of different types of interment space that will be needed to accommodate those who choose casket burial, cremation and in-ground burial, cremation and inurnment in a columbarium niches, or cremation and scattering.
- **Market Share:** The percentage of deaths likely to result in an interment within the cemetery system. This provides the percentage of total deaths per year that can be expected to be accommodated at City cemeteries.
- **Area required per lot:** Space required for each interment option, including the area needed for associated infrastructure (roads, buildings, utility corridors, setback, operations areas etc). This provides the unit area that serves as the multiplier for each interment type, yielding the actual land area required.

The capacity for Phase I of the new cemetery is 20 years (2013-2032). The number of deaths projected to occur in this time is based on information provided by City of Lethbridge Staff. This data was produced using City of Lethbridge census data, plus a projected A.D.R. (expected number of deaths/ year per thousand people). These projections were used in the 2006 LEES+Associates study, “City of Lethbridge Cemeteries Development and Management Plan.” For the current project, projections beyond 2006 were extrapolated from these figures, which provided the required numerical information for the Cemetery Business Case Analysis up to the year 2034 (year 25 of the analysis).

For this study, the number of interments recorded by Cemetery Services (2003 – 2009) was the basis of the analysis. Having access to accurate data for these seven years enabled the calculation of the annual average number of people who had chosen to be interred in a Lethbridge cemetery and the percentages of the different types of interment options that they chose.

Not every resident of Lethbridge chooses to be interred in a local cemetery; however, many *non-residents* choose to be interred in a cemetery within the City of Lethbridge. Comparing Province of Alberta statistics for total deaths in the City of Lethbridge with the number of interments that actually took place at a City cemetery produced an average "capture rate" or "market share" of 62%. This percentage reflects the combination of the relatively high number of casket burials (76%) and cremation interments (51%) that take place in Lethbridge cemeteries compared with the total number of deaths that occur in the City. Most of the remaining 38% of decedents either chose burial in another cemetery, cremation and burial or scattering in another cemetery, or scattering in a place of personal significance. A small percentage of cremated remains also end up in the possession of the family or the funeral home.

For the purpose of the conceptual plan, the area required per burial was based on the average area provided at Mountain View Cemetery for casket and cremation lot burials. Only casket and cremation lots were included in the initial land needs calculations because these interment types are the most common and the most space-consuming. Other options (columbaria and scattering) are not only extremely space-efficient; they are also very flexible and can be fitted into irregular areas and edges. For this reason, columbaria and scattering was not included at this level of conceptual design. Road area was also removed from the calculation.

The areas used to calculate conceptual land needs were:

In-ground casket lot: 5.16 m^2
In-ground cremation lot: 1.59 m^2

It should be noted that the number of lots per unit area at Mountain View is lower than many modern cemeteries. A smaller per-lot area and higher overall yield will very likely be possible at the new cemetery site due to its physical character and the ability to design a more efficient lot/utility layout. This is discussed further in the next section.

3. The New Cemetery: Conceptual Site Plan

The 90 acre/36.26 ha site acquired for the development of the new cemetery is located at 5310 13th Street North, approximately 800m north of Hardieville, Alberta. The site's legal description is NE 19-9-21-W4, Lethbridge. The property was purchased by the City in 1979 and was held for unspecified land uses until it was acquired by Cemetery Services in 2010 for $212,000. The property is zoned UR (Urban Reserve) and V (Valley). A 2010 aerial photo of the site is provided, below:

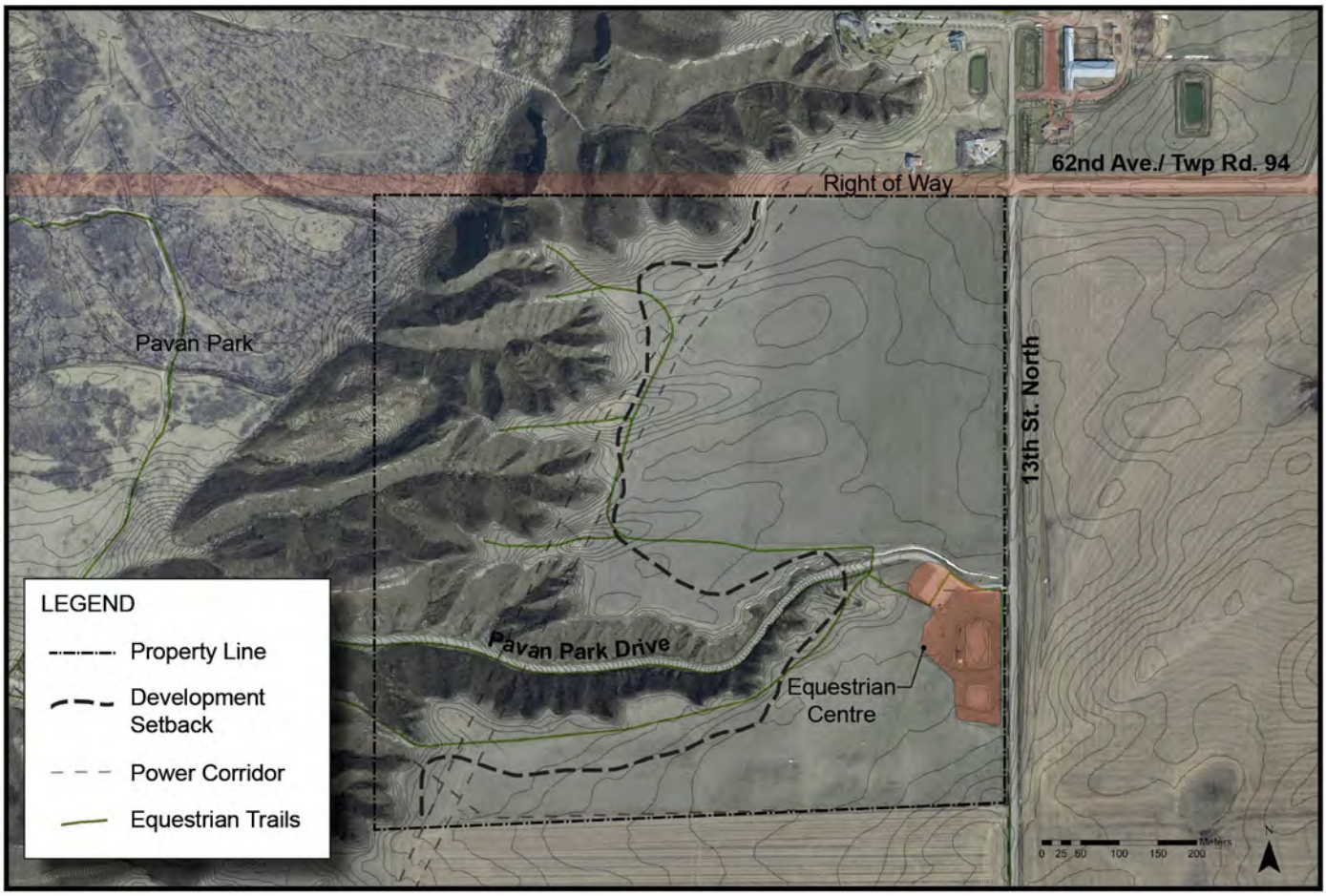


Figure 3: New Cemetery Site Existing Conditions, LEES+Asociates

Figure 4: Pavan Park Drive Crossing, LEES+Associates

The cemetery site straddles Pavan Park Drive, the access road that extends east from 13th Street North through a narrow coulee to Pavan Park. This park is the City's northernmost river valley park, offering equestrian and foot trails and picnicking next to the Oldman River. A marked equestrian trail extends up from the park and into both the north and south sections of the cemetery site.

Figure 5: Entrance to the Site, LEES+Associates

The section of the site north of the road (the "north section") is currently leased for hay production. The existing landscape character is open and slightly undulating. Three high voltage transmission lines run from the northwest to the southwest corner. The site is bounded on the north by the 62nd Avenue/ Twp Rd. 94 road right-of-way, which is developed only as far as the scattered homes just north of the site. The house and property fronting 62nd directly north of the site is owned by the Pavan Family, the former owners of the original parcel that encompassed Pavan Park and the cemetery site.

Figure 6: North Section of the Site, LEES+Associates

Figure 7: Transmission lines, with the Pavan Family Property in the background, LEES+Associates

The portion of the site south of the road (the “south section”) is occupied by the Whoop-up Equestrian Centre. This facility includes an outdoor arena, two outbuildings and an outhouse. The south edge of the site abuts land currently zoned as Urban Reserve. This land is managed for hay production but is expected to be subdivided and developed for housing in the future. The east edge is bounded by 13th Street North and the west edge abuts the coulee setback zone. Panoramic views over the coulee, with Rocky Mountains in the far distance, are visible from close to the coulee edge. The site’s high voltage towers are less of a visual impact on this section as they extend only along its narrow, westernmost tip.

Figure 8: Looking into the coulee, LEES+Associates

Figure 9: The Whoop-up Equestrian Centre, LEES+Associates

Planning parameters

The primary planning parameters for the new cemetery site were identified through the initial stages of concept development, including a study of site opportunities and constraints (see Appendix B). The physical concept plan that was developed as a product of these parameters is shown on the following page.

Figure 10

Lethbridge Future Cemetery Concept

LEES+Associates Landscape Architects

The planning parameters used in the conceptual design process are listed in the table below. A discussion of each parameter is provided in the following section.

New Cemetery Site: General Planning Parameters	
1 Capacity	▪ Planning area to include both north and south sections of the site ▪ Lot layout to meet projected interment needs for up to 100 years ▪ Phase I development to provide capacity for 20 years projected needs
2 Vehicle Access	▪ Vehicle access to be from the existing road infrastructure ▪ Road access into site to minimize conflicts with Pavan Park traffic ▪ Internal roadways to serve maximum number of lots (lots both sides wherever possible) ▪ Internal roadways to be spaced no more than 60 m apart (pall bearer walking distance) ▪ Possible service/maintenance and emergency vehicle access routes to be identified
3 Non-vehicle Access	▪ Exisiting equestrian and foot trails to remain, particularly connections to Pavan Park ▪ Possible connections to future North Lethbridge park and open space to be considered
5 Development Constraints	▪ All developed cemetery land to be outside of coulee setback line ▪ Irrigation to be permitted only outside coulee setback line ▪ Coulee edge zone to be retained as habitat/buffer zone and protected from cemetery-related impacts ▪ Cemetery activities/uses to be restricted to outside of existing power transmission corridor ▪ No disturbance of any known environmental or archaeological features to be permitted
5 Drainage	▪ Existing site hydrology and stormwater flows to be maintained (No additional drainage off site)
6 Aesthetics	▪ North and south sections to appear visually unified ▪ Power transmission lines, including wind-related noise, to be mitigated, as possible ▪ Landscape character to gradually ressemble that of Mountain View (more treed; sense of enclosure) ▪ Coulee edge views to be optimized (non vehicle access only) ▪ Buffer/transition area needed between the cemetery and roads, future surrounding development ▪ Significant entry features/amenities to be visible from approach
7 Administration	▪ Future building site to be identified for offices, reception, meeting rooms, washrooms, plus parking
8 Operations / Maintenance	▪ Area of minimum 1,200 m² to be identified for operations area, preferrably in low visibility area
9 Cost	▪ Phase I development costs not to exceed $2.8 million, exclusive of design/engineering ▪ Possible interim land uses of undeveloped area to be considered to defray maintenance costs ▪ Application for cemetery designation by the province has been made, but the initial year of operation will be on the basis of "Provisional Approval", which does not permit interments.
10 Timing	▪ Site to be developed for interments prior to Mountain View reaching capacity ▪ Planting and site development to preceed use by minimum 1 year for establishment of trees and sod

Figure 11: New Cemetery Site: General Planning Parameters, LEES+Associates

1. Capacity

Interment capacity—a key factor in the selection of the new cemetery site —was a primary consideration in developing a proposed layout. As noted in the previous chapter, the amount of land needed to provide the initial 20 years of projected interment capacity was based on the sizes and layouts of lots at Mountain View. Much of Mountain View was planned at a time when land costs were low and access by carriages and other

considerations were best dealt with by simply allocating extra space. The older sections of Mountain View also include an additional 2' utility corridor between rows of graves. The result is a per-lot yield below current industry standards.

Figure 12: Mountain View's layout, LEES+Associates

The following table provides a comparison between the typical lot sizes and resulting yields per hectare (ha) at Mountain View, compared with smaller lot sizes and resulting yields at many contemporary cemeteries.

Cemetery Capacity by Lot Size		
	Mountain View	**Industry Standard**
	Area per Lot (m²)	
Inground casket lot	5.16	4.75 - 5.0
Inground cremation lot	1.59	0.75 - 1.2
	Yield per Hectare	
Inground casket lots	1,938	2,000 - 2,105
Inground cremation lots	6,289	8,333 - 13,333

Figure 13: Cemetery Capacity by Lot Size, LEES+Associates

While lower yields are sufficient (and possibly preferable) for the purposes of conceptual planning, higher overall yields per hectare are likely possible at this site. The open and relatively level character of this site presents no obstacles to creating a highly efficient layout throughout the development area. Prior to the start of the detailed design, Staff should decide if—in the context of the new cemetery site—slightly smaller lot sizes (which still meet provincial standards) will be acceptable from

a marketing perspective, and functional from an operations perspective. If a slightly smaller lot is chosen, smaller scale operations and maintenance equipment (such as that commonly used in European cemeteries) could be considered.

An important means of increasing interment capacity is to minimize space dedicated to roads and services. Utilities, such as irrigation and drain lines, should be placed under roads and key pathways to minimize the amount of land they would otherwise require. While some utilities require dedicated easements, in many cases, certain kinds of development (even columbaria) can be accommodated over underground utilities. Combining multiple utilities in conduits can also help achieve higher capacity. Consolidating services facilities placement, repairs and maintenance.

During the detailed design stage, consideration of the build-out condition is recommended. Envisioning the final configuration of the site and its ultimate capacity could reveal how different areas of the site could transition as interment area is occupied. Areas that may serve as event space, access roads or habitat areas could, in the long term, be converted to columbaria, scattering and memorialisation space.

Whatever the per-lot size and refined configuration of cemetery sections, space beyond the basic interment area will also be needed for a variety of other uses, such as:

- roadways and parking;
- pedestrian pathways;
- landscaping (planting, water features etc);
- amenities such as buildings and other structures;
- public art, memorial and ceremonial space, and
- landscape buffers and setbacks from roads and future adjacent development

During the development of the conceptual plan, it was calculated that the cemetery would need 4,300 burial lots and 7,609 cremation lots to serve the community for the initial 20 years,

2012 – 2032. This represents an interment area of 2.77 ha. Once the roadways, entry and perimeter buffer areas were added in, the area required for Phase I development totalled **3.77 ha**. This figure was used in calculating the new site's Phase I development cost estimates.

It is worth noting that the business plan breaks down sales according to "pre-need" (interment space sold before a death has occurred) and "at-need" (interment space sold after the death has taken place), which is how every lot sale is categorized in cemetery records. This distinction is not, however, a factor in calculating projected land needs. By law, the only lots that can be sold are those that are already fully developed, so for the purposes of land planning, serving the interment needs of the community will include pre-need as well as at-need demand.

2. Vehicle access:

Since the new cemetery was to be planned as a single unit, a central location was required for vehicle access. A primary point of access from Pavan Park Drive was chosen, primarily to strengthen the connection between the two parts of the site. A north-south axial entry road is planned to lead to a future cemetery office building located in the larger, north section.

At the detailed design stage it will be important to keep the link between the north and the south sections as far east as possible. As the Pavan Park access road extends west, it begins to drop steeply into the coulee. The intersection of the entry road and Pavan Park Drive should be at a shallower gradient than currently possible, although this location is preferred in terms of it connecting more centrally to both sections. A larger design perspective will be required to find a solution that works on both counts.

Figure 14: Pavan Park Drive, LEES+Associates

The second reason for selecting this entry point is that 13th Street North is slated for future upgrading to an arterial standard. Once

complete, access into the cemetery from the south (requiring a left hand turn) would be difficult, and possibly unacceptable to the City's Transportation Department due to its close proximity to the intersection with Pavan Park Drive. While combining cemetery and park traffic is not ideal, it is anticipated that with road upgrading, the intersection of Pavan Park Drive and 13th Street North will be redesigned.

Figure 15: A potential entry location to the cemetery, off Pavan Park Drive, LEES+Associates

To address this issue, redesign could focus on accommodating the future conditions at this intersection, possibly incorporating traffic calming features such as a central landscaped median and paving materials, to define the cemetery entry corridor. A landscaped median could not only work to reduce the speed of park-bound traffic, it could also create a more dignified, ceremonial approach to the cemetery as a whole.

The internal road layout (north section) was developed starting with a perimeter loop, principally to maximize access but also to provide a direct, continuous route around the entire site. A curvilinear section along the west edge was created to respond to the irregular lot edge adjacent to the coulee. This section of roadway offers the opportunity for visitors to experience a different aesthetic experience relative to the rest of the site.

Figure 16: The edge of the new cemetery site, tapering off into the coulee, LEES+Associates

This section of road should, at the detailed design stage, be carefully designed to respond to the area's slight topographic variability, and the potential to open up views and physical access to the coulee edge. A secondary, more grid-like roadway system is proposed inside the perimeter loop. This system breaks the site into sections of no more than 120 meters in size, ensuring a pall bearer walking distance (from roads to gravesites) of less than 60 metres.

Road layout in the south section of the site follows a similar approach although the concept plan does not indicate a road extending into the narrow, west corner. The reduced width in this area and the proximity of steeply-banked edges suggests that this most remote section of the site is best suited for non-interment uses. The concept plan suggests that this area could provide a new location for the existing equestrian centre. Maintaining equestrian uses and horse trails connecting to the park below are important in order to retain the local history and character of recreation in this area. Related uses could also be integrated into this landscape buffer area, including future green burial (burial in a natural setting, without a headstone), or scattering areas.

The concept plan permits service and emergency vehicles to access the cemetery from the axial entry road and to use the perimeter routes to quickly reach all sections of the site. Possible secondary points of entry/egress should be considered at the detailed design stage.

3. Non-vehicle access:

At the conceptual level, site access by pedestrians would be from along the roadways except where linkages with trails are desired. Connections should be planned between the cemetery and the existing trail system developed by Lethbridge Parks. Red shale surfacing could indicate these connections with the site's recreational context.

Pedestrian access into cemeteries is typically controlled by perimeter fencing and gates. At a large site such as this,

installing perimeter fencing could constitute a significant capital cost. An acceptable level of pedestrian access should be determined as a function of broader site programming, and involve the City of Lethbridge Parks Department. A variety of access control strategies will be most effective in the short term. It is worth noting that installing some level of fencing along the west edge could help control the movement of deer from the coulee coming onto the cemetery at night to browse on the irrigated landscaping and graveside flowers. A visually inobtrusive wire fence, creatively designed, could be effective without impacting views to the west.

4. Development constraints:

Potential constraints to the proposed use of this site were identified in the feasibility studies undertaken by EBA Engineering Consultants Ltd prior to its acquisition by Cemetery Services. The results of these studies are summarized in the following reports:

1. August 28, 2009, Geotechnical Evaluation Proposed North Lethbridge, Lethbridge, Alberta
2. June 2009, “Phase I Environmental Assessment: 5310 – 13 Street North Portion of NE 19-009-21 W4M Lethbridge Alberta”
3. June 2009, “Geotechnical Evaluation of Slope Stability: Proposed Cemetery Development, Lethbridge Alberta”

Potential development constraints included:

- Soil stratigraphy (subsurface geology)
- Proximity of historic coal mining activities
- Groundwater conditions
- Slope stability

The studies concluded that site soils are not a constraint to the proposed use and meet the health and safety requirements of the Alberta Health Authority (i.e. can support grave excavations and will not likely contain groundwater at excavations of less than 2 meters). The site’s fine soils were noted, however,

as potentially capable of creating perched water tables, so monitoring irrigation effects to establish optimal rates will be required over the first few years of operation.

Groundwater data collected by EBA was based on nine test holes drilled at different locations around the site. At the request of Alberta Health Services, these boreholes were monitored for depth to water. The results of this review (August 18th and October 8th, 2010) confirmed that groundwater at the new cemetery site is well below the depth of future graves, and verified that hydrology and soils at this site are not constraints to cemetery development. Findings were submitted to Alberta Health (See Appendix C).

Historic mining operations were also determined to not represent a constraint to development as there are no known shafts within the development area. Slope stability was, however, discussed as a major consideration, as it is for any site in the vicinity of the steep coulees that frame the Oldman River. Slope stability was addressed through maintaining the existing low levels of soil saturation and ensuring that development is kept away from the top of bank along the coulee edge. The coulee setback was the primary constraint considered at the time of concept development.

Coulee setback:
The conceptual plan indicates a development setback described in the 2009 EBA slope stability report. This report notes that the line was developed in accordance with the “River Valley Area Redevelopment Plan”, City of Lethbridge By-Law # 5277. The development setback applies to the development of conventional burial plots, roads, and buildings. Construction of other features for which a failure of the coulee slope would not pose an excessive risk to citizens (i.e. development of trails, lookout points, etc.) is still permitted. Consideration should be given to the placement natural burial sites, as well as trails and other landscaping features within the development setback. These uses are subject to approval of the applicable regulators, the City, and the recommendations of the geotechnical engineer.

The development setback demarcates a setback of 4 H:1V from the elevation at the top of the Lenzie Silt Layer (at 875m) and represents the distance to which, in a worst case scenario, the slopes above the silt layer could retrogress. The EBA report lists development guidelines relevant to the new cemetery site, which have been considered in the preliminary concept for the site and should be incorporated in the detailed design phases. These recommendations include:

- Restrictions on irrigation within the restricted development zones;
- Restrictions relating to earthworks and ground disturbance, and
- Providing EBA the opportunity for further review prior to construction.

The report included a statement that, “Automatic irrigation sprinkler systems for the property should also be prohibited.” This statement was later clarified (May 27th, 2010, personal communication with Trevor Loomer, EBA). Automatic irrigation of landscaped areas east of the development setback line will be permissable since this will not impact slope stability. Automatic irrigation is essential to the health and appearance of turf, trees and other plants at this site. Current irrigation technologies are very sophisticated and can be designed and programmed for specific irrigation rates and timing. This can result in minimal water-use to achieve the desired standard. All proposed landscaping indicated on the concept plan is east of the development setback line and will be irrigated.

Hand irrigation (by cemetery or parks staff) of dryland landscape species over the first few growing seasons would be permissable on an as-needed basis if it is determined that shrubs are desirable inside the setback zone, along the top-of-bank trails.

The site’s electrical transmission corridor was the second constraint considered at the time of concept development.

Electrical transmission corridor:
Three high voltage power lines traverse the cemetery site. These lines, which connect the power produced at generating facilities to substations, transport electricity at voltages ranging from 69 kV (69,000 volts) to 500 kV (500,000 volts). The lines are owned by Altalink, which has confirmed that there are no current plans for any changes to this corridor beyond the possible upgrading of the remaining wooden poles to steel. (Apr 28, 2010, personal communication, Justian Wylie, Land Manager, Altalink)

Due to safety concerns, Altalink prefers that its lines do not cross sites where equipment will be used. Where development is proposed adjacent to an existing corridor, Altalink requires that a site plan be submitted for review in order to ensure that their height restrictions and equipment clearance setbacks requirements are met. This submittal to Altalink should be made at the detailed design stage.

The power transmission lines, shown in the photos below, were reviewed in light of their visual impact, and their occasional auditory impact—a hum resulting from power losses that can occur during specific air and temperature conditions.

Figure 17: Altalink transmission lines border the cemetery site. LEES+Associates

Figure 18: The transmission lines currently exist adjacent to agricultural lands. LEES+Associates

All interment space indicated on the concept plan is east of the corridor; however, the transmission towers are very tall. It is unlikely that their visual impact can be eliminated from all aspects of the cemetery due to the generally flat and open

site character. The noise generated by the towers is perhaps even more difficult to mitigate, especially in a contemplative environment such as a cemetery. Visual screening may reduce the apparent level of noise, but the most effective strategy for managing noise will be maximizing the distance between the corridor and the cemetery's interment areas. Fortunately, the hum is intermittent only and reportedly at its worst in rainy or foggy conditions, when fewer visitors are likely to be on site. The concept plan proposes a significant evergreen tree buffer along the east side of the power corridor. Large, spaded conifers in varying sizes and staggered for a more natural effect are proposed immediately east of the development setback line, as close as possible to the actual corridor. Some land forming (such as shallow berms) may also be considered to further mitigate the prominence of the towers, although any grading adjacent to the top of bank should be reviewed to make sure that it will not impact slope stability.

The value of the undeveloped corridor area to wildlife is also worth noting. In the face of impacts that cannot be completely addressed, making interpretive information available to the public is sometimes effective. Such information may be helpful to acknowledge public sensitivities to the presence of power lines at a site such as a cemetery. Explaining how the cemetery is working to create the most attractive and respectful place possible, in spite of features beyond its control, indicates a level of engagement and inclusion that can be effective in overcoming adverse public perceptions. The safety of visitors spending time in the vicinity of the power lines is another issue that may be worth touching upon.

Two additional potential physical constraints to development were identified through the background reviews: the potential presence of environmentally significant areas and possible archaeological significance.

Environmentally Significant Areas:
The site has been actively cultivated for many years; however a darker patch apparent on aerial photos as early as 1979 suggested the presence of a possible wetland in the north section, east of the power transmission corridor. An "ephemeral wetland," was noted in the Phase I ESA of this site and later cited in the 2009 EBA Geotechnical study. Since further development of a wetland area would require approval under the Alberta Water Act, this area was field checked by a representative from EBA. The area was found to be a slight depression low enough to retain moisture capable of keeping crop species slightly greener during the summer, but shallow enough that it did not contain any wetland soils or support any wetland plant or animal species. The proposed construction of entry area water features will more than compensate for any impacts created by development of this site.

Figure 19: The bright green depression shown in this photo holds moisture at a higher rate than the remainder of the site. LEES+Associates

This finding removed any development constraints that would have been associated with a true wetland. The letter summarizing this assessment was sent to Alberta Health Services (see Appendix D.)

Archaeological significance:
The site was also assessed for possible archaeological significance by Arrow Archaeology Ltd. Field investigation found no evidence to indicate that this site has specific archaeological significance. An Historical Resources Impact Assessment (HRIA) has been prepared and submitted to the Province of Alberta's Heritage Resource Management Branch.


Figure 20: A stormwater berm currently runs along the edge of the site. LEES+Associates

5. Drainage:

As noted in geotechnical studies, the site's fine-grained soils tend to cause rainwater to run off the surface rather than be absorbed, so even relatively small storm events can produce runoff. Existing drainage, both on-site and over the larger area, is towards the Oldman River via the coulees. A low berm was recently constructed along the west edge of the neighbouring agricultural land (across 13th Street North) to control runoff during a storm event. This berm contains storm water on the east side of the road and releases it slowly through a pipe opposite Pavan Park Drive, resulting in runoff flowing down the paved roadway. There is also a substantial grassed swale along both edges of Pavan Park Drive to convey runoff from both sides of the cemetery site.

The concept plan proposes to maintain the current general drainage pattern, including the current drainage of stormwater runoff from east of 13th, down Pavan Park Drive. Development of the cemetery as shown on the concept plan will not create significant new impermeable area. It is therefore not expected that the site will significantly increase stormwater runoff.

Impermeable Area: Conceptual Cemetery Plan			
	Area (m²)	**Impermeable (m²)**	**Impermeable (%)**
Casket Grave	3.3	0.36	11%
Bldg footprint, incl'd paving	500	500	100%
Works Yard, incl'd equip storage	1,000	1,000	100%
Parking, incl'd driveways	2,800	2,100	75%

Figure 21: Impermeable Area: Conceptual Cemetery Plan, ELAC

The use of non-polymer soil additives should be considered to improve the moisture retention within the shallow soil layers and reduce irrigation requirements.

6. Aesthetics:

Cemetery aesthetics are a vital consideration in the success of the facility. Overcoming the relatively remote location, the visual impact of the power transmission lines and the absence of trees or other existing natural features at the new site will require an investment in developing and installing aesthetic features.

The visual integrity of the site across the north and south sections were considered important to ensure that interment space on both sides of the site is equally valued. A consistent road layout and a “street tree” planting scheme (trees along both sides of roadways) are proposed to achieve this effect. This will also serve to moderate the visual presence of the power lines.

Figure 22: Tree-lined road at Mountain View Cemetery, LEES+Associates

Figure 23: Rows of trees are seen as an aesthetic characteristic of the cemetery, LEES+Associates

Most residents of Lethbridge appreciate the well-treed character, sense of enclosure and varied landscaped areas at Mountain View Cemetery; however, few would believe that this site was once as open and featureless as the new site. A comparison of an historic image of Mountain View with the new cemetery site illustrates their similarities and serves as a reminder of what trees, irrigation and time can accomplish over the long term.

Mountain View Cemetery, 1920s

Mountain View Cemetery, 2010

The concept plan proposes extending a generous entry area landscape across the edges of Pavan Park Drive to tie the north and south sections together. The key aesthetic feature proposed on the concept plan is a “system of ponds” depicted as flanking the intersection of Pavan Park and 13th Street North. These ponds are proposed primarily as aesthetic features, but the ponds as shown have been designed (in terms of size and location) to also retain stormwater drainage. The ponds, which will likely need to be lined with a clay or other liner, will retain runoff collected from impermeable surfaces throughout the cemetery site. Stormwater will either be conveyed in shallow swales and/or concrete gutters that define and visually demarcate road edges, and through subsurface drain lines that will connect the pond system. The ponds are envisioned as naturalistic in character: irregular in form, with planted edges to accommodate water levels that will fluctuate approximately 600 mm in depth. Mechanical equipment for these ponds could be housed in a pumphouse that could also accommodate washrooms for visitors.

The opportunity to develop an internal water feature area exists in the vicinity of the “ephemeral wetland.” A pond in this area could provide a focus for the northwest section of the cemetery. Information on wetland planting species and techniques are provided in Appendix E. Precedent imagery depicting proposed character for constructed ponds at this site is provided below:

Figure 26: Constructed stormwater detention pond, LEES+Associates

Figure 27: Sunridge - Constructed Pond, LEES+Associates

Much of the design for aesthetic features will take place during the detailed design phase. The site's lack of existing vertical features should be addressed, possibly with constructed elements at the entry. Entry features and signage should be designed to be visible from the site approach along 13th St. N. Wall structures, even relatively low walls, can be effective entry features in combination with water and generous plantings. The character of all site walls should convey dignity and permanence and be constructed of quality materials. The design should reflect a "contextual" quality, so the character of the walls fits and looks appropriate to its southern Alberta context.

Perimeter buffer plantings should be located to punctuate the edges, providing broken views into the site but buffering views and noise from traffic along 13th Street North. Concentrations of evergreen trees are indicated to create transition zones between interment space and future surrounding developments, particularly the residential area to the south. Other areas where screening should be concentrated are along the power transmission corridor and adjacent to the operations yard. Xeriscape species and planting techniques should be employed wherever possible, notably along the perimeter of the developed area. Establishing drought tolerant species early will enhance the character of the site over the longer term, as well as reduce irrigation water demands. Information on dryland planting is provided in Appendix F.

Glimpsed views to coulee access trails and rocky overlooks should be provided along the roadways. Subtle land forming in buffer areas can create an attractive counterpoint to the more formal landscape of the in-ground interment area.

7. Administration:

A future administration building, which would house offices, a reception area, meeting rooms and washrooms, are located within the red polygon in the north section of the site. This area was selected due to its central location and its visibility from 13th Street North. The proposed area to be allocated for the building

is 500 m2, which could accommodate a 3,000 s.f. building plus pedestrian areas and associated landscaping. An additional 2,800 m2 is included in the polygon for parking for up to 100 vehicles plus driveways.

It is likely that some scale of building will be required within the first two years of operations. A temporary, modular structure may be a more cost-effective alternative to a conventional building, at least until the level of use and activity at the cemetery can justify a more permanent structure. The interim building should be included in the detailed design for Phase I, providing washrooms, offices and a lunchroom space for administration and maintenance staff.

8. Operations and Maintenance:

The concept plan includes a site for an operations yard of the scale of the current facility at Mountain View (approximately 1,000 m2). It is located to have the least visible impact, while still being relatively central. Screening is indicated along the edges to minimize its impact on views from the road and on adjacent interment areas. A second, smaller operations area may be desirable in the south section as well, at least for materials storage.

9. Cost

The total cost of the Phase I cemetery development was estimated by the City in 2007 to be $3,600,000. This was the amount applied for and awarded under a grant under a provincial MSI (Municipal Sustainability Initiative). Capital project funding was approved in the 2010 Capital Improvement Program cycle. Allocation of this funding to specific City operating budgets is intended to send a signal to residents and Funeral Home operators that the City is committed to constructing the new cemetery in North Lethbridge, to a standard commensurate with other City services.

The concept plan was developed to the construction budget of $2.8 million, which included the $212,000 cost of the land.

- An additional $800,000 was allocated for design, construction costs and contingency.
- Site works, including hard and soft landscaping, accounted for approximately $2,000,000.
- Site furnishings and fixtures accounted for an additional $80,000. Building costs for the modular structure and an operations building were budgeted at $345,000 and $45,000.

(See Appendix G for the complete cost estimate breakdown.)

10. Timing:

The capital funding for Phase I development was approved based on construction beginning no later than 2011, with anticipated completion by 2012. This timing allows for the new cemetery to operate for one year prior to any interments taking place at the site, per the “provisional approval” status initially granted by the province to new cemetery sites.

Completing construction of the new cemetery before interment space is completely sold out at Mountain View has the additional benefit of providing time for the landscaping to become established. Trees and turf both tend to be healthier and more tolerant of use if given time to establish. Plantings will also have time to establish and fill in, providing a more positive visual effect than immediately after planting. Similarly, a slightly longer lead-time between the cemetery’s completion and its assuming the role of city cemetery from Mountain View will give residents of Lethbridge some time to get used to the idea of the new cemetery being in the north of the City.

A name for the new site should be selected by the City of Lethbridge prior to the start of construction. A simple name, relevant to the site and the Lethbridge area (such as “Coulee Ridge Memorial Park”) or a phrase incorporating a local, historic feature or place would be best. The name should be put into use, including public announcements about the project, to create a public presence and “identity” for the site.

Cemetery Programming

Over the past few years, there has been a movement within North American cemeteries to expand their role from providing only interment services, to hosting and providing a venue for non-interment related events. This reflects a new trend to diversifying cemetery programming ("programming" referring to everything that is expected to - i.e. should and could - occur at a cemetery site.)

The impetus for this trend seems to be a growing desire to restore links between cemeteries and the communities they were established to serve. Cemeteries are achieving this objective by finding ways to increase the public's perception of cemeteries as relevant and attractive places. They are seeking to broaden public expectations of what a cemetery is and does, and to establish a place for cemeteries in the system of public open spaces and cultural landscapes. This movement seems strongest in places where many people have either lost their ties to the local cemetery as a place of family burial, or where many people are newcomers with no historic ties to the site, and often little understanding of the history of their new home.

Figure 28: Foothills cemetery in Boston, MA hold a number of annual programmed community events, http://www.foresthillstrust.org/about.html

In an urban context, enhancing public awareness and understanding of the roles that cemeteries can play in the day-to-day life of a community can build support for broader public uses. This can include less traditional uses, such as providing space for recreational uses and cultural events. This in turn can enhance the perceived value of cemeteries in the public parks and open space system. Educational components, focusing on environmental aspects of a site for example, can explain how a cemetery can also be an arboretum and habitat area for local wildlife, which further expands the public's appreciation of the role of cemeteries in the community.

Most of the new programming now being introduced into cemeteries still has links with the traditional purpose of cemeteries—providing places to remember and honour those buried on their grounds. Such events typically have roots in the

cultural traditions of other places, where there are set times each year for families to gather and pay respects to ancestors by visiting and tending their grave sites. Examples of such ceremonies include the *Chinese Quingming* ("tomb-sweeping day"), the Japanese *Obon* (Buddhist celebration of the return of the souls of ancestors) and the Mexican *Día de los Muertos* (Day of the Dead). Where these more recent celebrations differ from traditional events is in their focus on providing opportunities for the public to celebrate those who have passed on in a family-oriented community event, drawing on a wide variety of traditions that are linked by a strong arts component.

Forest Hills Cemetery in Boston, Massachusetts is a leader in this movement. This cemetery now operates a non-profit arts and culture Education Trust, whose role it is to preserve, interpret, enhance, and celebrate the cemetery as a place of burial and remembrance, as well as providing a valuable historic and urban green space. Forest Hills programming includes musical concerts; sculpture exhibits; poetry readings; history, birding and arboricultural walks, and a popular annual lantern festival.

Figure 29: Programmed events at Forest Hills Cemetery include public art displays, http://www.foresthillstrust.org/about.html

Figure 30: A sculptural elements at Forest Hills Cemetery, http://www.foresthillstrust.org/about.html

Mountain View Cemetery in Vancouver and Royal Oak Burial Park in Victoria, B.C. are two Canadian cemeteries that, over the past few years, have been hosting increasingly well-attended, annual events. Mountain View (Vancouver) has retained the services of an "artist in residence," and draws on the City's

graphic and historic resources to sponsor public art installations and provide space for a range of activities

In the case of Mountain View (Vancouver), the recent development of a large, new columbaria area has essentially reopened the cemetery to sales for the first time since 1986. A new administration building, an operations area and a Celebration Hall—a multipurpose events space—were constructed with funds projected to be recuperated through niche sales and revenue from the rental of the new Celebration Hall. Hosting public events has helped to publicize the availability of cremation interment space and to reach out to the community at large, including those who may never use its more conventional cemetery services.

Figure 31: The recently completed Celebration Hall at Vancouver's Mountain View Cemetery. LEES+Associates

Figure 32: An exhibit at Mountain View's annual Night for All Soul's event, LEES+Associates

http://vancouver.ca/commsvcs/nonmarketoperations/mountain-view/allsouls/index.htm

The potential for broader cemetery programming is relevant to Lethbridge at this time since new City cemetery will represent a significant shift in the location, operation and character of local cemetery services. Establishment of the new site represents the first time the City has had the opportunity to operate a cemetery that it has also selected and designed, and the opportunity to consider creative uses of special sections of the site—perhaps in combination with related initiatives at Mountain View. The shift from an urban to a more rural context may require some additional outreach and engagement with the public. Public art and special events should be considered as a vehicle to help

introduce and engage the community with its new cemetery. In terms of its size and location, the new cemetery site is well-suited to becoming a future community event location, especially as Lethbridge expands north. The site affords panoramic views over the coulees, which could provide a dramatic context for public art exhibits, outdoor music concerts and lectures, and a range of annual memorialisation events. Naturalist tours, bird walks, and hiking, biking and equestrian trails are highly compatible with this location. The rocky promontory in the northwest section could be carefully designed for public access, but in a way that will not impact the broader viewshed. If developed, an internal pond site could provide a focal point for water-related events and displays. The water features at the entry could also be designed to accommodate appropriate displays.

Although not a part of Phase I, the future administration building could be programmed to include flexible community use space. This could be rented out as a celebration hall, providing a venue for funerals, memorials and formal events, as well as less formal gatherings and community functions. The revenue-generating potential of such a facility should be assessed at the time of architectural programming and design.

The City of Lethbridge currently allocates 1% of the annual community services capital budget for the purchase of public art, and a public art master plan is slated to be developed in the near future. There are four pieces of City-funded public art currently installed in Lethbridge, reflecting the City's connection to the Canadian Pacific Railway and its relationship with wind—a characteristic quality of its prairie context. Suggested themes for other art pieces include the City's history as coal-mining town and the once prevalent prairie buffalo, both of which are relevant and appropriate to the new site. The new cemetery could become the site of permanent or temporary art installations, and in the longer term, could become a future location for community art events such as "ArtWalk", as it continues to expand beyond the downtown core.

A detailed Programming Brief, which itemizes and describes the range of programming to be considered at the new site, is included in Appendix H. The following graphic provides a schematic illustration of how programming considerations should inform the detailed design of the new cemetery site.

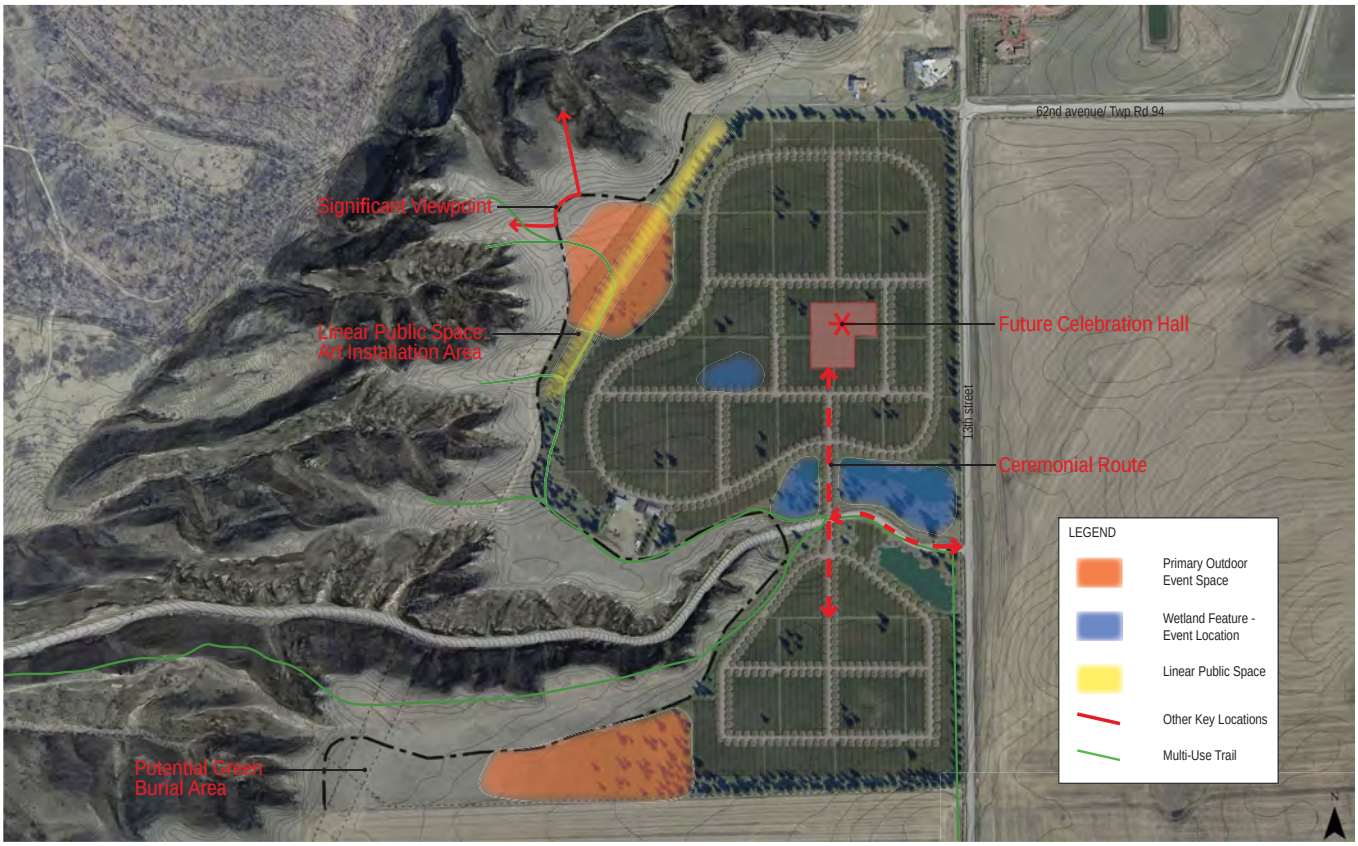


Figure 33: Proposed programming elements for the new cemetery site. LEES+Associates

Development strategy

Potable water

Domestic water for the new cemetery site can be provided through a service connection from the recently installed Picture Butte water supply pipeline, which runs along 13th Street North to supply water from the Uplands water reservoir to communities north of the City of Lethbridge. The anticipated domestic water requirements of the new cemetery site would be relatively small; therefore, a small diameter water service lateral similar to those used to service a residential property would be adequate for the washrooms and small kitchen of the Phase I cemetery building.

A connection to the domestic water system could provide irrigation water for new cemetery site, at least in the short-term. In this case, the service connection to the main water pipeline should be sized to minimize pressure losses and provide adequate capacity for the ultimate cemetery irrigation system. In the long-term, a connection to the St. Mary Reservoir Irrigation District (SMRID) irrigation canal system may be preferred as a source of non-potable water for irrigation and pond make-up water. Initial discussions with the SMRID indicated that they would be receptive to provision of water to the cemetery site. The City would, however, be responsible for obtaining or re-allocating an appropriate water license for the cemetery site. All improvements required to bring water from the SMRID canal system to the new cemetery site would also be at the City's expense. Four options delivery of non-potable water to the new cemetery site are presented for discussion below.

Option 1 - Construct a new turnout and pumping station where Township Road 94 (62 Avenue North) crosses the SMRID canal and install approximately 2,600m of pipe from the canal to the northeast corner of the new cemetery site.

Option 2 - Extend the existing irrigation water supply system that provides make-up water to Chinook Lake by approximately 3,600m to the new cemetery site.

Option 3 – Obtain an agreement with the property owner to the northeast of the cemetery site to utilize the existing pipeline and pump to deliver water to the new cemetery site. The parcel of land lcoated north of 62 Avenue North and east of 13th Street North is supplied with non-potable water from the SMRID canal system by a pipeline and pump station located approximately 250m from the northeast corner of the cemetery site. Through an agreement with this property owner, it may be possible to deliver water to the new cemetery site through this existing pipeline system.

Option 4 – Obtain an agreement with the property owner to the east of the cemetery site to utilize the existing private pipeline and pump to deliver water to the new cemetery site. The section immediately east of the cemetery site is irrigated by a pivot system. The pivot system is located 1,200m from the northeast corner of the new cemetery site. It is believed that the property owner may be planning to discontinue irrigation of this parcel. Through an agreement with this property owner, it may be possible to deliver water to the new cemetery site through the existing pipeline system.

Should the City wish to pursue a non-potable water supply for irrigation of the new cemetery site, an evaluation of these four options should be undertaken in consultation with the affected stakeholders.

Domestic wastewater

A septic tank and absorption field would likely be adequate to treat the volume of domestic wastewater generated by the cemetery office building. If there is concern regarding infiltration of treated effluent, a holding tank could be provided and the City could enter into an agreement with a waste hauling company for regular pumping of the tank. It is expected the cemetery offices would be connected to the City's central wastewater collection and treatment system when sanitary sewer services are extended to this area of the City. Provision for the future connection to the City's central wastewater collection should be incorporated at the detailed design stage.

Stormwater

The existing storm drainage system in the area of the new cemetery consists of open ditches with culverts at driveway and road crossings. Runoff from a large portion of the new cemetery site is concentrated to the south edge of the site at the existing roadway to Pavan Park. The proposed development concept involves construction of ponds along the north section of Pavan Park Road as entry features and to control stormwater runoff from the site. The ponds could also serve as a source of water for irrigation within the cemetery, supplemented by water delivered through the potable water distribution system or SMRID irrigation system.

Within the new cemetery site, the increase in impervious area that will result from development of the cemetery is relatively small compared to other forms of development. Low Impact Development (L.I.D.) techniques can be used to mitigate the increased storm runoff from the site and promote water quality improvement, particularly during low-intensity and short return period events. This could include landscaped dry creek beds and rain gardens to detain stormwater; however, the low permeability of the native soils and concerns regarding slope stability will limit the disposition of stormwater through infiltration. Runoff from the site will be directed to the ponds where it will be detained until it can be released in a controlled manner or utilized for irrigation.

Consideration must be given to the design of any ponds on the site to ensure that they do not influence groundwater levels to the point that they affect the active working depth of the plots. This may require hydrogeological modeling and specification of pond linings at the detailed design phase to minimize seepage of water stored in the pond system.

To minimize the initial and replacement cost of infrastructure, a minimal amount of storm drainage piping would be provided within the cemetery site. Similar to other parks in the City, an overland drainage system would convey the majority of stormwater runoff to the outlets from the site. Site grading will follow the existing ground topography as closely as practical

while creating positive drainage to the ponds. A minimum finished ground slope of approximately 1% is recommended within the overland drainage system to ensure positive drainage of the site. Piped storm drainage piping would be utilized only where proper drainage cannot be achieved through surface grading.

In the burial area, techniques should be used to promote surface drainage and minimize the percolation of water into the void spaces of lots internment. Compaction may be advisable to reduce this problem. It may also be possible to grade rows of lots (minimum 2%) to create positive drainage to the overland stormwater conveyance system.

The ultimate outlet for the largest portion of the stormwater runoff from the site will be the Pavan Park Road. It is expected that as urbanization of North Lethbridge continues, a new trunk storm sewer will eventually be installed under this road to serve lands east of 13th Street North. Stormwater detained in any on-site ponds could be released to this trunk storm sewer via outlet structures constructed for the ponds. Runoff from other areas of the site which naturally drain over the edge of the coulee slope will continue to drain in this manner. Care in the final grading and landscaping must be taken to ensure that surface water released over the coulee edge is not concentrated to specific points of discharge.

4. Spatial Need Analysis and Assessment

New Cemetery

A spatial needs analysis was undertaken in the course of developing the physical plan for the new cemetery site. This process (outlined in Chapters 2 and 3), verified the physical area required to meet interment needs for 20 years in Phase I of the development.

Outside of this area, initial development should include plantings wherever trees are needed to establish an effective visual buffer. Planting to screen the power transmission corridor is the first priority, followed by buffer plantings along 13th Street North and then the southern edge of the south section, to screen views from future lots on this development site.

In view of the large scale of the cemetery site, interim land uses for at least part of the site should be considered. Suggested options include:

1. **Maintaining part of the site for agricultural use.** This could alleviate the burden of managing the more remote sections of the site although it would not likely yield significant income. It could, however, reduce the area that will require mowing and weed control by the City.

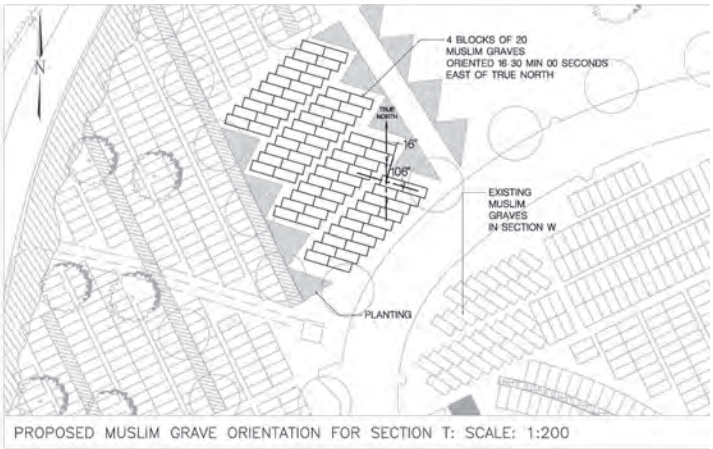
2. **Establishing a tree nursery for cemetery purposes.** The City purchases approximately 500 trees per year, however, it is difficult to predict the number and specific varieties of nursery stock that will be needed over a 6 -10 year horizon. Private nurseries are currently providing good quality stock to the City at fair prices, so there is little incentive for investing in this venture. There may, however, be some broader benefit to the cemetery in establishing a nursery for its own purposes.

3. **Developing fields for sports teams and other groups active in North Lethbridge.** The need for additional sports fields and an archery range in Lethbridge has been discussed. The Lethbridge Department of

Recreation and Culture notes that with low population density in North Lethbridge, and sufficient facilities in other areas of the city, developing new facilities at the cemetery site is not currently warranted. The situation should be reviewed again in 2012, once Scenic Drive North Extension (9th Ave N to Stafford Dr North) has been competed, and recommendations from the upcoming Recreation and Culture Master Plan Update have been submitted.

The new cemetery site provides an opportunity for Cemetery Services to offer larger, pre-designated sections of lots to religious or other special interest groups. Such groups may wish to have their own interment area with features and layouts appropriate to their specific cultural or religious traditions. Lethbridge has a history of providing this service, as demonstrated by the Catholic, Protestant, Chinese, Japanese and Jewish sections at its existing cemeteries. Large blocks of graves for new groups have not been possible until now. Lethbridge's Muslim community, for example, is estimated at over 500 residents and growing. They (among others) should be contacted regarding the opportunity to pre-purchase contiguous blocks of lots.

Such purchases (which should be appropriately priced) would be beneficial to the cemetery in generating immediate cash flow. Specific features that could be installed (through arrangement with Cemetery Services) during Phase I development would also help establish a presence for the site.



Muslim graves require an accurate east-west orientation, so this should be considered at the detailed design stage. Distinctive layout can introduce variety and create interesting design opportunities, as illustrated in the adjacent cemetery layout graphic.

Figure 34: An example of muslim grave orientation and layout, LEES+Associates

Existing Cemeteries

Spatial need assessments were conducted for the existing cemetery sites of Mountain View and Archmount. The process involved collaborating with Cemetery Services on candidate areas to identify possible additional capacity. This process was undertaken; first on the basis of air photos and then on the basis of a site-by-site field review.

The objective was to identify opportunities to infill lots in underused areas, or to convert space designated for one type of use to other more desirable uses. The relative cost and lead time required to realize such new capacity was an important consideration. Potential interment capacity was identified by type (casket lots, cremation lots and columbaria). Since casket lots are the product in shortest supply and greatest demand, wherever casket lots could be accommodated, potential capacity was shown as casket lots.

Unused and underused areas are indicated on the following four plan sheets. The first sheet for each site is an “Opportunity and Constraints” plan. The second sheet is a refined schematic, “Potential Additional Interment Capacity”, that suggests exactly how each area could be developed or otherwise optimized. (See Appendix I for photos of each of the areas considered.)

It is important to note that there are capital costs associated with achieving increased capacity at the existing cemeteries, and that such investments can only forestall the need to construct a new cemetery. Non-tax-based funding options are available to undertake discrete projects at Mountain View and Archmount. Such initiatives could enhance the capacity and place of the existing cemeteries within the system, but should not defer the development of the new site, for which funding has already been secured and allocated.

Figure 35

a Existing flower bed and trees. Suitable for future development.

b Area and road from the front entrance are outside of fence.

c Rarely used road. Area could be reclaimed for an extension to the Japanese Section (19).

d Redundant north/south road. Mature ash trees create an established character.

e Along the roadway, adjacent to existing in-ground burial. Scots pines create an established character.

f Could be reconfigured once the operations yard is relocated to new cemetery.

g & j Potential family columbarium area. A sewer line runs under this area - reason for current lack of use.

h Close to the Japanese section. Area could tie into the existing columbarium area; could also be enlarged to the read immeidately south as needed.

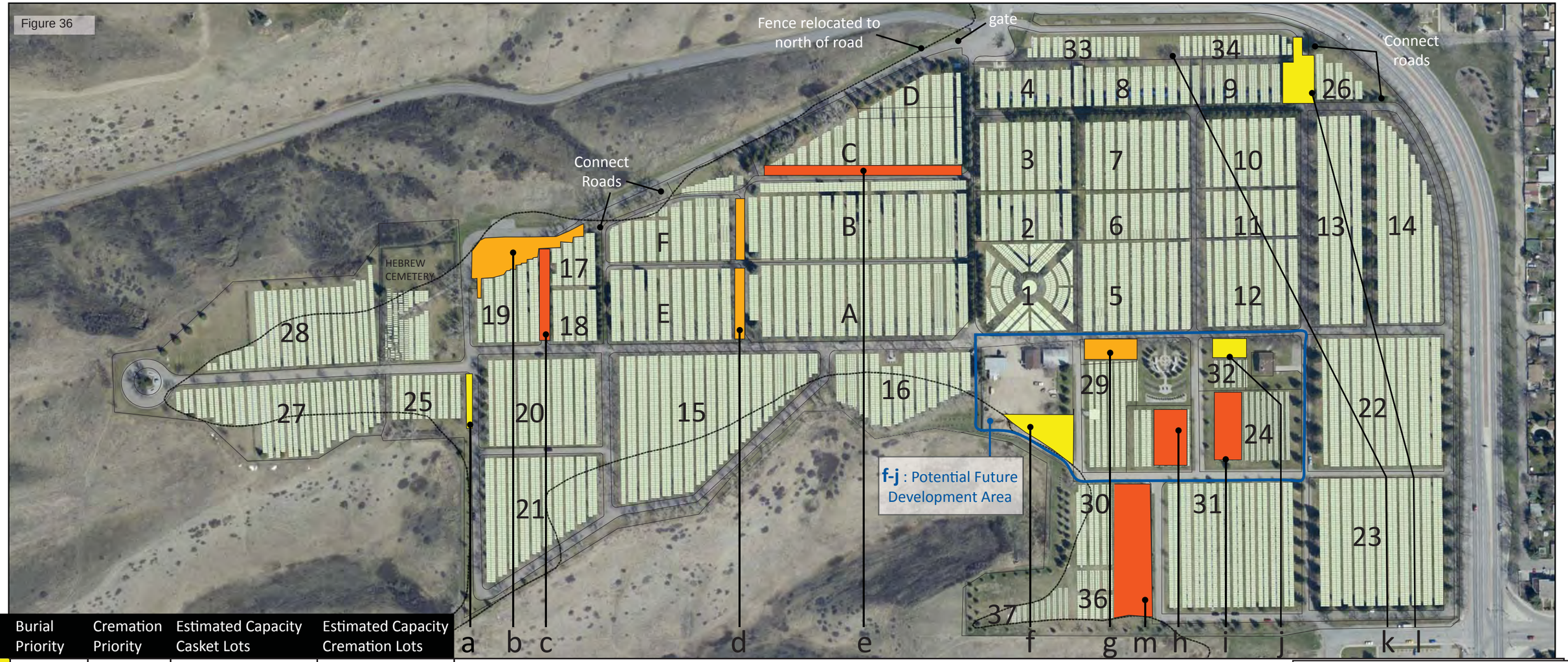
i Cremation lots. Section has been open for 30 years with very slow sales. Could be converted to cremation garden.

k Presently designated for columbarium. Soil saturation in Blocks 33 and 34 has increased in recent years.

l Unused edge area.

m Potential excess capacity in existing Field of Honour.

Figure 36



	Burial Priority	Cremation Priority	Estimated Capacity Casket Lots	Estimated Capacity Cremation Lots	
a	n/a	3	n/a	80	Develop in-ground cremation lots.
b	2	3	180 OR	~660	Develop in-ground casket lots. Relocate fence to outside of road, add vehicle gate at entry. Connect to area “c”.
c	n/a	1-2	n/a	250 lots/864-1152 niches	Develop cremation lot or columbaria along a pedestrian path. Connect n-s road to e-w road immediately north.
d	2	n/a	160	n/a	Add 2 rows of in-ground burial by extending from the east, into the existing ROW.
e	1	n/a	200	n/a	Extend in-ground burial rows south, as tree roots permit.
f	3	n/a	120	n/a	Develop in-ground burial in south half of Operations Yard. Retain northern half for equipment and storage.
g	n/a	2	n/a	~320 niches	Develop columbaria per existing sewer lines to building. Remove or relocate lines infrastructure.
h	1	n/a	186	n/a	Develop in-ground casket lots as indicated on current lot plan. Extend to the road.
i	1	1	240 OR	570	Laid out for cremation lots. Could be used to create a cremation garden.
j	n/a	3	n/a	120	Develop cremation lots. Include Martin Brothers building site for more cremation capacity at termination of lease. (2016)
k	n/a	n/a	n/a	n/a	Enhance edge treatment, consider closing adjacent road. Address problem groundwater with leak detection survey (water service)
l	3	n/a	150	n/a	Develop casket lots on existing n-s road. Connect perimeter road on edge of area, maintaining existing sewer line setbacks.
m	1	1	320 AND	132	Make a portion of the Field of Honour casket and cremation lots available to public.

f-j Potential Future Development Area: Post closure redesign of central area as a whole to meet long term programming needs.

LEGEND

- ‘a’ Zones with available capacity
- Priority 1: 1-5 years
- Priority 2: 5-10 years
- Priority 3: long term option
- Setback line/limit of use
- Potential Future Development Area

0 25 50 100M

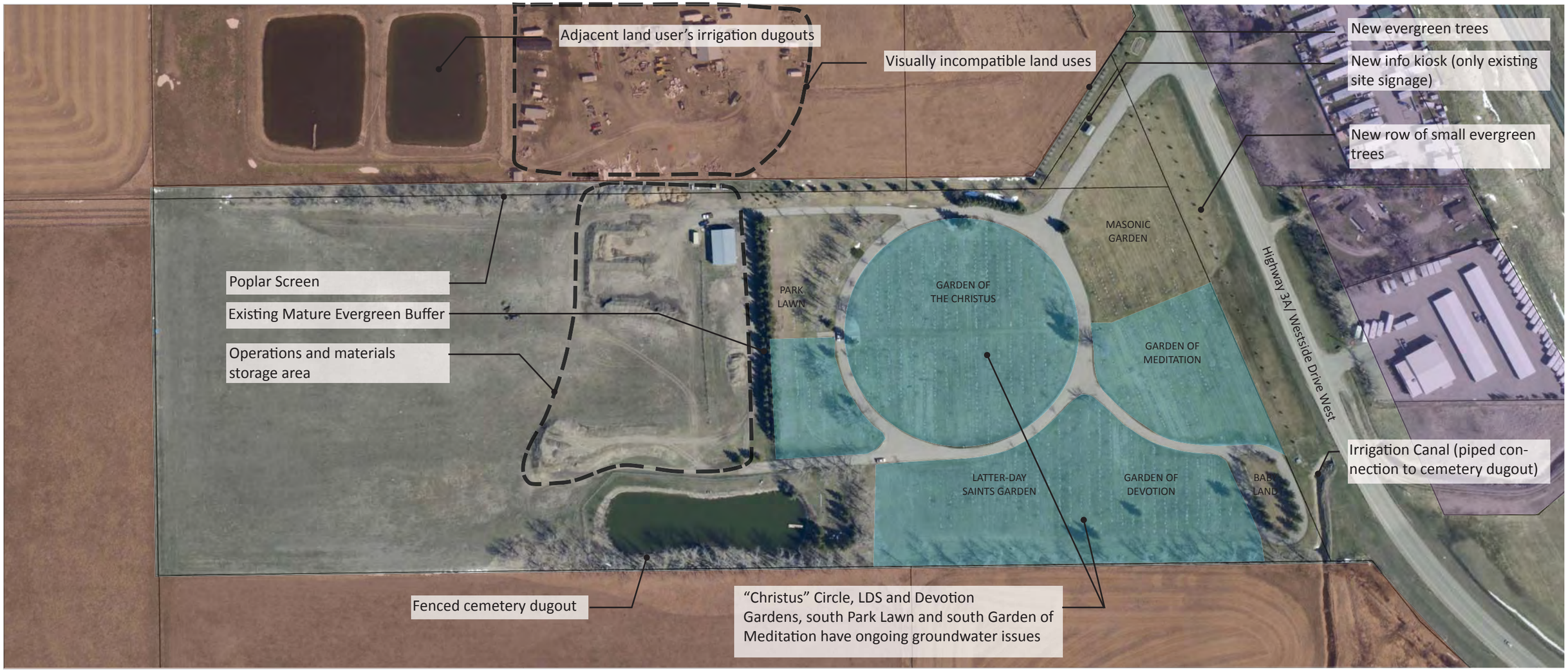
N

Mountain View Cemetery | Spatial Needs Analysis - Potential Additional Interment Capacity

September 13, 2010

LEES+Associates Landscape Architects

Figure 37



ARCHMOUNT: SALES AND INTERMENTS 2000-2009

Year	Lot Sales	Interments
2009	4	48
2008	18	67
2007	18	59
2006	11	69
2005	17	62
2004	3	62
2003	12	76
2002	N/A	73
2001	N/A	53
2000	N/A	71

2010 SALES, JANUARY - AUGUST 31ST

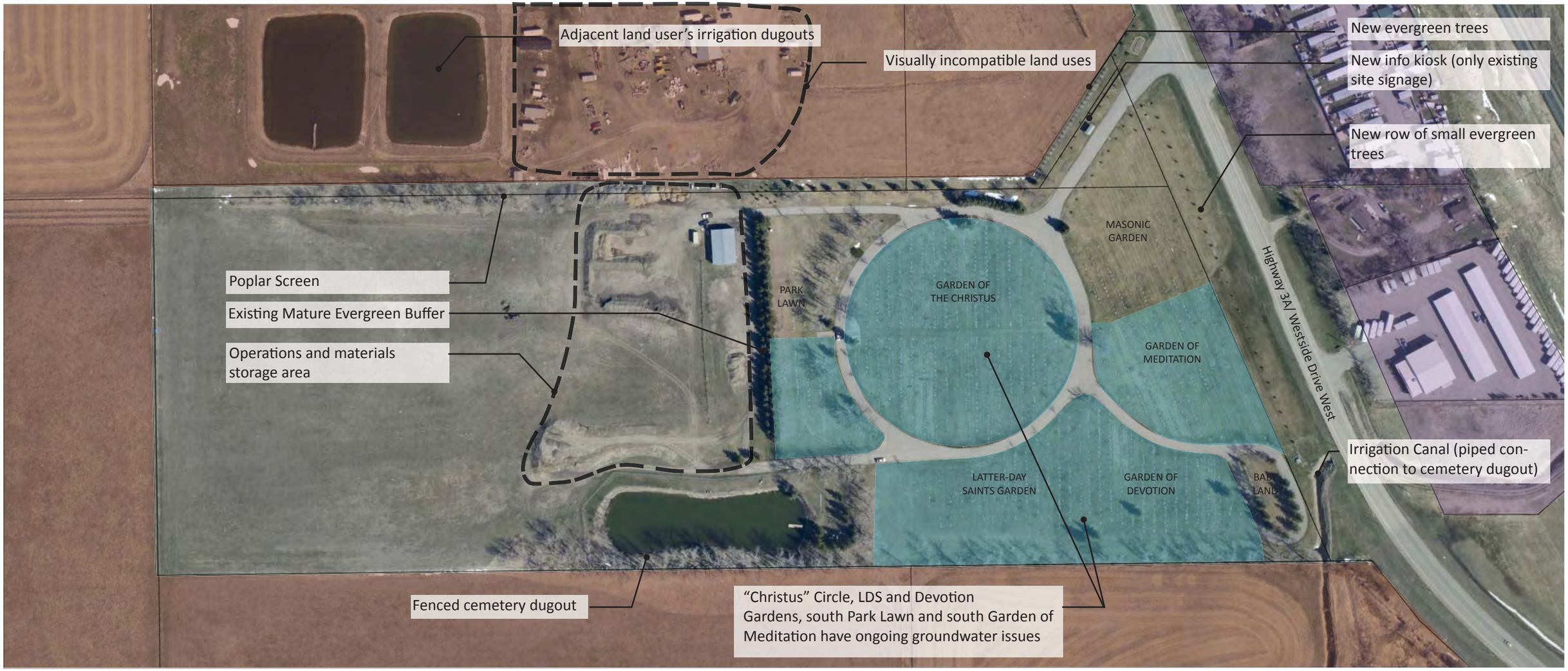
Type	Quantity
Lot Sales	13
Casket Lots	21
Cremation Lots	16
Prepaid O & C	8
Total Interments	45

LEGEND

- Previously Urban Reserve District - Rezoned as Commercial/Industrial
- Direct Control District
- Existing Groundwater Issues

0 25 50 100M

Figure 38



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LEGEND

- Previously Urban Reserve District - Rezoned as Commercial/Industrial
- Direct Control District
- Existing Groundwater Issues

0 25 50 100M

Mountain View Cemetery:
This process determined that if all areas at the cemetery were developed as depicted on the plans, casket capacity could be increased by approximately 1,550 lots. At a rate of 250 sales per year, this represents approximately six years of casket lots. Just under half of these lots (about 740 or three years of demand) could be created through realignments or reallocations within existing interment areas that have excess capacity relative to current demand.

One example of such an area is the Field of Honour. This area serves veterans only and therefore does not address the problem of the cemetery's diminishing inventory of casket lots available for sale to the general public. Re-allocating some of the lots within specially-designated areas would be relatively straightforward and would not require significant capital investment.

The balance of capacity identified (about 810 lots) could be created in areas not currently developed for interment purposes. The development of this new capacity at Mountain View would, however, require significant capital investment.

As well as the areas noted above, The Hebrew Cemetery at Mountain View is an area with significant unused capacity. This site is privately owned, though maintained by Mountain View under an agreement with Cemetery Services. Few interments take place there each year. It is recommended that Cemetery Services approach representatives to determine if part of the unused capacity within its boundaries could be acquired and some lots offered for sale to the public at-large.

The process determined that where casket lots would not be possible, available space would accommodate approximately 900 niches. At the current rate of +30 niche interments per year, this represents approximately 30 years worth of new niche capacity.

The long term role of Mountain View should be to provide for at-need interments only and to focus on offering a range of

cremation interment options. Its focus should be to serve families with existing ties to this site.

Archmount Cemetery:
The process yielded a less specific result at Archmount. The primary recommendation is that the undeveloped area at Archmount be returned to the City Reserve. The extent of undeveloped land at Archmount is far beyond what could ever be successfully developed for interment capacity at this location in the City. See “Sales and Interments 2000 – 2009” on the “Archmount Cemetery Opportunities and Constraints Plan.” This cemetery is increasingly compromised by surrounding zoning, including that proposed in the recent West Lethbridge Employment Centre Area Structure Plan. Based on the history, perception and challenges of operating a cemetery at this location, it is recommended that Cemetery Services divests of Archmount’s 15 undeveloped acres and focuses on using a portion of the revenue to make improvements to the existing developed area. This will ensure that capacity still available at this site (1,663 single depth casket lots) can be more effectively marketed and maintained than is currently possible.

Figure 39: Family Columbarium at Capilano View Cemetery, District of West Vancouver, BC, LEES+Associates

In the short-term, a portion of the west parcel can continue to be used for municipal storage. A buffer area between the developed cemetery and the surplus lands should be retained to serve cemetery and municipal needs, and to serve as a buffer between the cemetery and future uses. A swale along the boundary between the remaining cemetery and the new parcel should also be built to intercept surface water and direct it to the existing pond. Cemetery Services should work with the adjacent landowner to investigate possible leaks in the pressure pipeline running along the north perimeter. Water in this line is pumped from the irrigation canal to fill the existing dugouts north of the maintenance building and could be contributing to groundwater issues.

Likewise, the City may wish to approach Lethbridge Northern Irrigation District (LNID) regarding long-term plans to pipe the existing irrigation canal. Should a pipe be installed, an alternate means of draining surface water may be required as the canal

appears to currently receive runoff from the site. A short-term alternative may be to partner with the LNID to line the existing irrigation canal to prevent problem seepage into the cemetery.

The City has an obligation to the families who purchased lots at this site to maintain it to a standard comparable with other City cemeteries. Capital investment is required to upgrade the aesthetics and functionality of the site. Original design features and elements require restoration. Plantings should be restored or replaced once drainage issues have been addressed, with a focus on perimeter planting along all edges. The upright monuments now preferred by most customers are not possible at Archmount; however, cremation interment options should be added to offer the same interment options as offered at Mountain View.

Figure 40: Family Columbarium at Mountain View Cemetery, Vancouver, LEES+Associates

Investment should be made in the following areas:

1. Drainage infrastructure
2. General upgrading of basic site features and aesthetics
3. Incorporation of cremation interment options

Techniques such as using grave-shoring structures, soil amendments to reduce irrigation needs and backfilling graves with compacted, low-permeability soils may help deal with operational issues at the site.

The long term role of Archmount should be to serve families with existing ties to this site and residents of West Lethbridge.

Figure 41: Family Columbarium, Sweden, LEES+Associates

St Patrick's Cemetery:
St Patrick's Cemetery is closed to new sales and so was not reviewed for additional capacity. Even as a closed "Pioneer Cemetery," however, St Patrick's could accommodate niches in small columbaria distributed throughout the site. The property adjacent to St Patrick's is owned by Lafarge Cement but its industrial use is subject to change. Once this occurs, the quality and desirability of the cemetery will improve. In the meantime, the focus of this site should be on serving the community primarily as a park and heritage resource. Besides future

columbaria, improvements should include signage, landscape enhancements and possible interpretive signage.

The following table provides a summary of the findings of the spatial needs analysis and assessment process.

Spatial Needs Analysis and Assessment: Key Recommendations	
New Cemetery	
	■ Proceed with detailed design and development of Phase I. ■ Determine extent of planting beyond Phase I area. Install mitigation plantings where needed in future development phases. ■ Identify location of potential blocks that could be developed for presale and use by specific religious or special interest groups. ■ Determine interim land uses for areas that will not be developed in the short or medium term.
Mountain View Cemetery	
	■ Reclaim unused/underused areas including roadways. ■ Allocate part of unused Field of Honour to non-military interments; make available to sales to the general public. ■ Integrate columbaria and/or cremation lots into areas unsuited for inground casket lots. ■ Work with representatives of Hebrew Cemetery on potential to acquire some portion of unused interment area. ■ Consider redevelopment of core "Potential Development Area" post 2016 (admin transferred to new site; end of crematorium bldg lease).
Archmount Cemetery	
	■ Evaluate the sale of the western, 15 acre undeveloped area. ■ Address drainage issues to facilitate sales and interments in existing inventory of developed lots. ■ Invest in key upgrades including exisitng site features, entry area and signage, and plantings.

Figure 42: Spatial Needs Analysis and Assessment: Key Recommendations, LEES+Associates

Possible “Green Burial” in Lethbridge

As a final point, there is an opportunity for the City of Lethbridge to consider expanding interment options at its existing and new cemetery sites to include “green burial” (also known as “natural burial” and “country burial”). The defining characteristics of this type of interment include:

- No embalming;
- Burial directly in the ground;
- No use of grave liner or vaults;
- A fully biodegradable burial container (casket or shroud);
- Interment sites planted with indigenous ground cover, and
- No individual grave markers

While green burial is still relatively rare in Canada, interest in this option is growing. Over 10% of all deaths in the United Kingdom now result in green burial. Canada’s first green burial site, “The Woodlands” at Royal Oak Burial Park in Victoria, has been in operation since November 2008. There are an average of two interments per month at this site. Offering this form of interment would not require any additional infrastructure (or the use of irrigation). It has the potential to increase capacity at Mountain View by designating green burial areas in the small, unusable “fingers” of land along the top of bank at the coulee edge. A possible location well suited to this type of use is depicted in the image below.

Figure 43: A potential green burial setting at Mountain View, LEES+Associates

Cemetery System - Levels of Service

City of Lethbridge residents have expressed high expectations for cemetery maintenance and aesthetics. Cemetery Services has responded by maintaining a high standard of operations, service and maintenance, particularly relative to many other comparably-sized municipal facilities. Cemetery Services has made arrangements with the Parks Department to take advantage of available in-house resources and expertise; however, cemetery maintenance is labour-intensive due to the large number of graves, headstones and special features.

The attractive cemetery environment comes at a cost. Where these costs should be within the spectrum of municipal services is subject to discussion over time. Proposals to reduce standards at cemeteries can elicit strong public response due to the unique historic and cultural role of cemeteries within the broader community. It should be borne in mind that allowing maintenance-sensitive features such as trees and monuments to decline due to reductions in maintenance can make it very difficult to restore them, should priorities change in the future.

5. Implementation

The implementation of this Master Plan will include a series of steps in each of the sections included in this report:

Development of the new cemetery site:

1. Approval of the cemetery concept plan by way of Council approval of this document
2. Issue of a Request for Proposals (R.F.P.) for detailed design of Phase I of the new cemetery site
3. Review of proposals, selection of a qualified consultant team and the award of contract
4. Completion of detailed design process and production of construction documents
5. Tendering of the construction documents package
6. Review of tenders, selection of a qualified general contractor and the award of contract
7. Construction of Phase I of the new cemetery by the end of 2011
8. Official opening of the new Lethbridge Cemetery and start of sales of interment lots

Improvements to existing cemetery sites:

1. Development of a prioritized project list based on availability of resources
2. Development of a plan to divest of surplus undeveloped lands at Archmount
3. Commissioning of engineering services to determine drainage strategy for Archmount

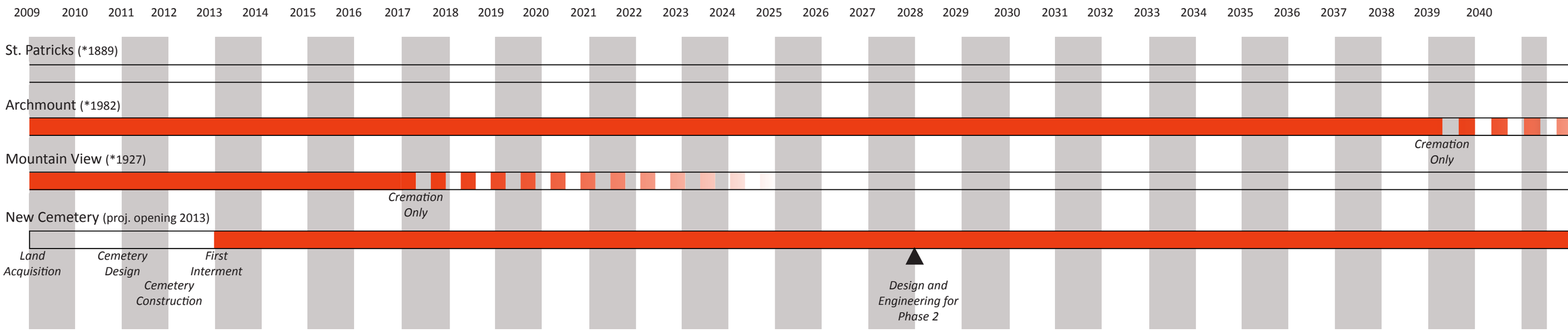
4. Implement improvements to Archmount Cemetery

5. Develop a plan to create additional interment capacity at Mountain View Cemetery

6. Implement improvements to St Patrick's Cemetery to enhance its role as the City's Pioneer Cemetery

The following timeline illustrates the projected roles and evolution of the cemeteries discussed in this report. The key underlying concept is that these cemeteries constitute a system, with each site contributing capacity and variety to the interment, memorialisation and open space opportunities available to the residents of Lethbridge.

Figure 44



Casket and Cremation Interment

Cremation Interment Sales Only

Inactive Cemetery (no interments)

Capital Investment

* Year cemetery was assumed by the City of Lethbridge

6. Conclusion

Lethbridge Cemetery Services is at a transitional point. Cemetery operations, management and infrastructure are poised to undergo a shift in how cemetery-related products and services are provided in the City. The success of the transition period will depend on the careful and systematic implementation of its recommendations, as well as continued collaboration with other City departments, cemetery customers and residents.

The Cemetery Services business unit is well positioned to proceed in a manner that will build on the current resources, and achieve the desired level of financial viability, customer service and contributions to the standard of living in Lethbridge.

7. Appendices

Appendix A: Bibliography
Appendix B: New Cemetery Site: Opportunities and Constraints
Appendix C: EBA letter, October 13, 2010, re: groundwater monitoring
Appendix D: EBA Letter, Sept 15, 2010, re: ephemeral wetland at new cemetery site
Appendix E: Stormwater Wetland Design Update:Zones, Vegetation, Soil, and Outlet Guidance
Appendix F: City of Lethbridge Dryland Plant Palette and City of Lethbridge Xeriscape Planting Report (AE Com December, 2009)
Appendix G: Phase I Budget Cost Estimate May 2010
Appendix H: Programming Brief
Appendix I: Spatial Needs Analysis: Photo inventory of proposed infill sites (Mountain View and Archmount)

Appendix A: Bibliography

Alberta Health Services. New Cemetery Development. Memo dated May 12, 2010.

City of Lethbridge. City of Lethbridge Cemeteries Bylaw 5004. December 23, 1999.

City of Lethbridge. Cemetery Services Strategic Business Plan 2009 – 2011.

Crowson, Belinda. Vice, Virtue and Lust: Lethbridge's Cemeteries. Lethbridge Historical Society, May 2008.

EBA Engineering Consultants Ltd. Dewatering Feasibility Study: Archmount Cemetery, Lethbridge, Alberta. December, 2007.

EBA Engineering Consultants Ltd. Geotechnical Evaluation Proposed North Lethbridge Cemetery Development, Lethbridge, Alberta. August 28, 2009.

EBA Engineering Consultants Ltd. Geotechnical Evaluation of Slope Stability Proposed Cemetery Development, Lethbridge, Alberta. June, 2009.

EBA Engineering Consultants Ltd. Geotechnical Evaluation Proposed North Lethbridge Cemetery Development Lethbridge, Alberta. letter dated May 12, 2010.

EBA Engineering Consultants Ltd. Groundwater Assessment Archmount Cemetery Lethbridge, Alberta. August 25, 2004.

EBA Engineering Consultants Ltd. Phase I Environmental Assessment: Cemetery Development (5310 – 13 Street North Portion of NE 19-009-21 W4M Lethbridge Alberta). June, 2009.

LEES+Associates Ltd. City of Lethbridge: Cemeteries Development and Management Plan: Final Report. July 20, 2006.

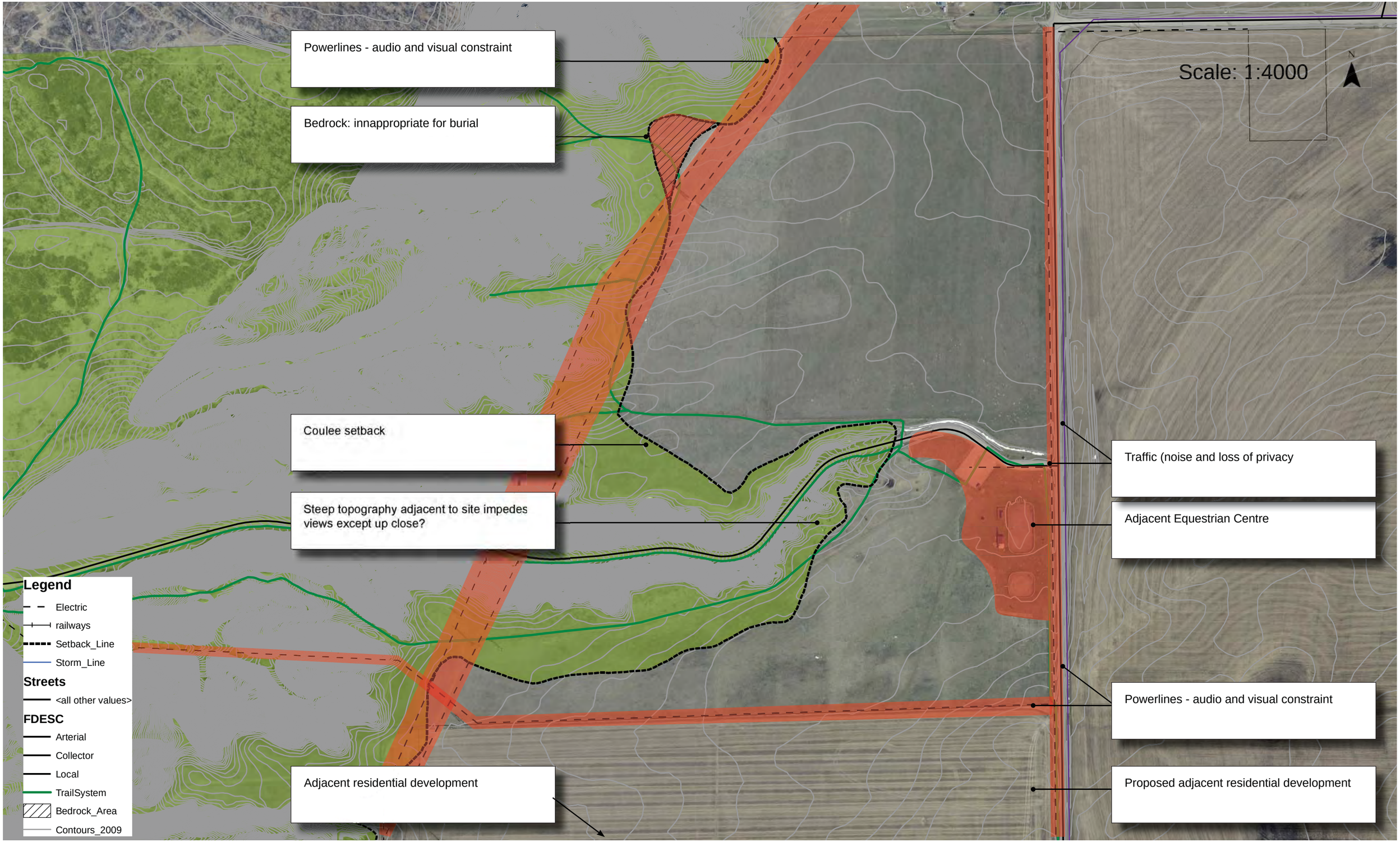
Province of Alberta Cemeteries Act (Alberta Regulation RSA 1980, C-2 Section 4), January 1, 2007.

Stantec Consulting Ltd. Lethbridge Cemetery Development and Management Plan. September 2000.

http://www.lethbridge.ca/home/City+Hall/Departments/Cemeteries/default.htm

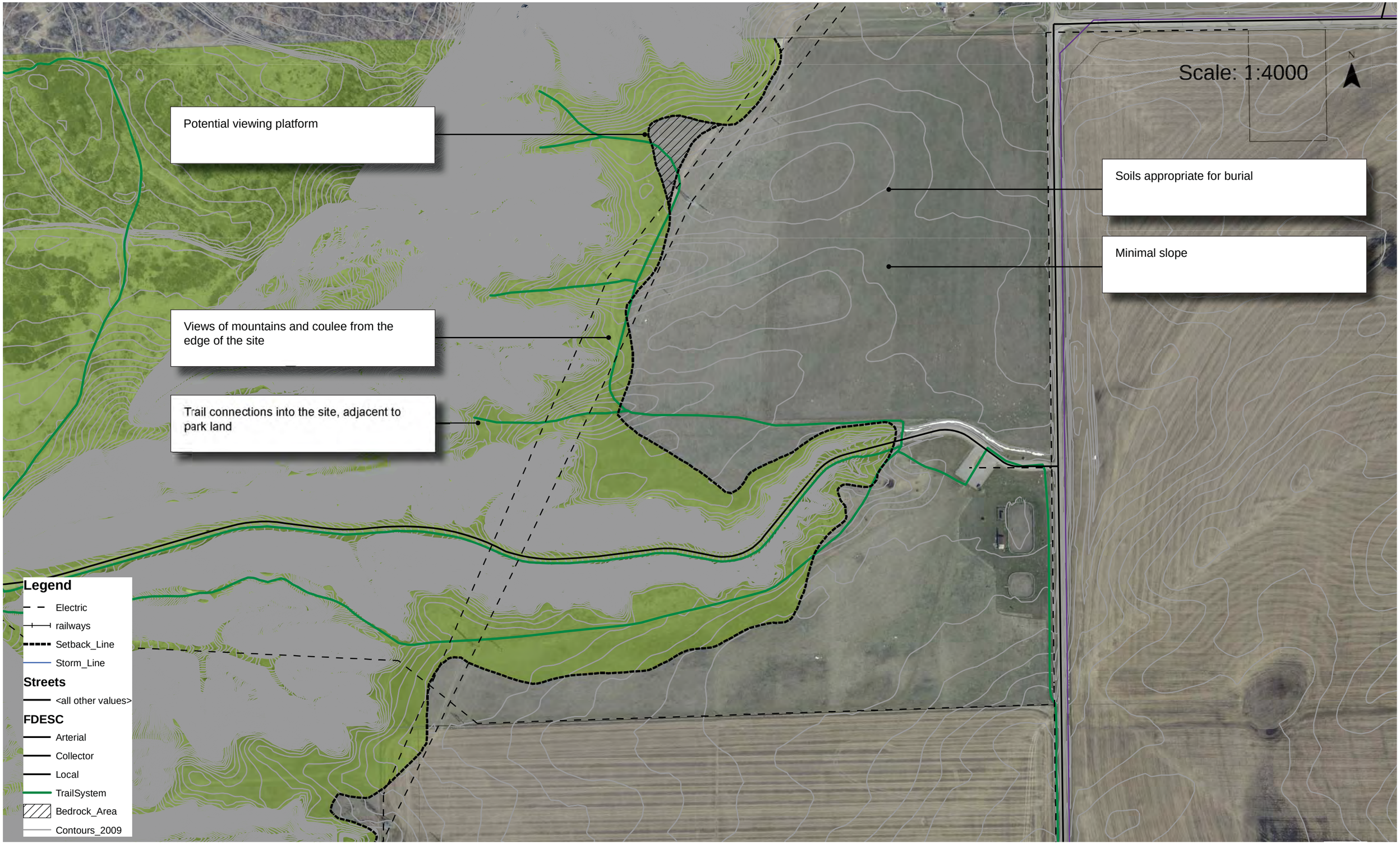
http://www.chooselethbridge.ca/business/population.php#demographics

Appendix B: New Cemetery Site: Opportunities and Constraints



Lethbridge Cemetery Constraints

LEES+Associates
Landscape Architects



Lethbridge Cemetery Opportunities

LEES+Associates
Landscape Architects

Appendix C: EBA letter of October 13, 2010, Re: groundwater monitoring

October 13, 2010 EBA File: L12101611

City of Lethbridge
910 – 4 Avenue S
Lethbridge AB T1J 0P6

Attention: Mr. Hiroshi Okubo

Dear Sir:

Subject: Geotechnical Evaluation
Proposed North Lethbridge Cemetery Development
Lethbridge, Alberta

1.0 INTRODUCTION

This letter presents a second set of results for groundwater monitoring as a follow up to a geotechnical evaluation conducted by EBA Engineering Consultants Ltd. (EBA) in August 2009 for the proposed cemetery development located in Lethbridge, Alberta. The first set of results was submitted in a letter dated May 12, 2010.

Authorization to proceed with the work was provided by Mr. Hiroshi Okubo.

1.1 GROUNDWATER CONDITIONS

The groundwater level was measured on October 8, 2010. The relative ground elevations were surveyed at the time of the original geotechnical evaluation and represent elevation relative to an arbitrary benchmark chosen on site by EBA personnel (the concrete base for a garbage container at the existing parking lot). The following table summarizes the groundwater monitoring data.

TABLE 1.1

Borehole Number	Depth of Standpipe (m)	Relative Ground Elevation of Borehole (m)	Groundwater Monitoring Data		
			Depth to Groundwater October 8, 2010 (m)	Depth to Groundwater May 10, 2010 (m)	Depth to Groundwater August 18,2009 (m)
001	4.6	999.72	DRY	DRY	DRY
002	4.6	1,000.74	DRY	DRY	DRY
003	4.6	1,000.10	Unable to locate	4.10	DRY
004	4.6	999.18	4.13	4.15	DRY
005	4.6	1,000.10	DRY	DRY	DRY
006	4.6	1,000.21	Unable to locate	DRY	DRY
007	4.6	1,001.53	DRY	DRY	DRY
008	4.6	1,000.72	DRY	DRY	DRY
009	4.6	999.79	Unable to locate	DRY	DRY

The local groundwater levels fluctuate seasonally and in response to climatic conditions. It should be noted that these readings were taken during the rainy season. The groundwater levels shown generally represent perched groundwater trapped within local sand and/or gravel layers, and do not represent a true phreatic surface.

2.0 CLOSURE

We trust the information provided meets your request requirements. Should you have any questions, please contact this office at your convenience.

Respectfully submitted,
EBA Engineering Consultants Ltd.

Trevor Curtis, E.I.T.
Project Engineer
Engineering Practice
Direct Line: 403.329.9009 x252
tcurtis@eba.ca

/rcm

Appendix D: EBA Letter of Sept 15, 2010, re: ephemeral wetland, new cemetery site

September 15, 2010 EBA File: L22101288

City of Lethbridge
910 – 4 Avenue S
Lethbridge AB T1J 0P6

Attention: Mr. Hiroshi Okubo

Subject: Comments on Ephemeral Wetland
Proposed Cemetery in Portions of 19-009-21 W4M
Lethbridge, Alberta

Dear Mr. Okubo:

As per your request, EBA Engineering Consultants Ltd. (EBA) has reviewed the Phase I environmental site assessment (ESA) report and the Biophysical Impact Assessment (BIA) report (EBA File: L22101288) and also conducted a recent site visit pertaining to the location of a suspected ephemeral wetland on the proposed cemetery site.

The reports reviewed were:

- Phase I Environmental Site Assessment

  5310 – 13 Street North

  Portion of NE 19-009-21 W4M

  Lethbridge, Alberta, June 2009

and

- Biophysical Impact Assessment

  Proposed Cemetery in Portions of 19-009-21 W4M

  Lethbridge, Alberta

  L22101288, September 15, 2009

In the Phase I ESA report, EBA identified an historical ephemeral wetland through the aerial photo review. This wetland was not visible during the BIA assessment. When visiting the site on June 1, 2010, a wetland assessor found that there was no standing water visible on the site and it appeared that the pasture land had been graded and seeded for pasture grasses where the former ephemeral wetland was present. This condition was observed despite significant prior rains.

Based on the review of the reports and subsequent site visit, it is concluded that the wetland is no longer present on the site.

EBA Engineering Consultants Ltd.
p. 403.329.9009 • f. 403.328.8817
442 - 10 Street N • Lethbridge, Alberta T1H 2C7 • CANADA

Should you have any questions or comments, please feel free to contact the undersigned at your convenience.

Respectfully submitted,
EBA Engineering Consultants Ltd.

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/hms

Appendix E: Stormwater Wetland Design Update

URBAN Waterways

Stormwater Wetland Design Update:

Zones, Vegetation, Soil, and Outlet Guidance

Many stormwater wetlands have been built in North Carolina since 2000, particularly in the Neuse, Tar-Pamlico, and Cape Fear River Basins. After examining many of these wetlands, N.C. State University researchers have revised existing design guidelines. Specific design focus points include:

- a redefinition of internal wetland zones,
- a revised list of herbaceous plants that have been found to commonly thrive in stormwater wetlands,
- a review of a proper growing medium, and
- the importance of a flexible outlet structure and its construction.

This fact sheet updates and revises *Designing Stormwater Wetlands for Small Watersheds* (AG-588-2) and is a companion to *Stormwater Wetland Construction Guidance* (AG-588-13).

RECENT RESEARCH

Stormwater wetlands reduce pollutant loads in stormwater runoff and thus have become preferred stormwater management tools. Studies across North Carolina have revealed that both stormwater wetlands and wet ponds trap sediment effectively, but stormwater wetlands remove nutrients and mitigate temperatures more efficiently than wet ponds:

- A stormwater wetland studied in Johnston County reduced nitrogen and phosphorus concentrations by over 80 percent, well above state-assigned removal rates.
- Studies conducted in Charlotte found removal rates of 40 percent for total nitrogen and 55 percent for total phosphorus.
- A study in the mountains indicated that a well-vegetated stormwater wetland reduced outflow temperatures by 3 to 5˚F more than wet ponds, which are unshaded and exposed to sunlight.

In areas with high water tables or a reliable base flow, which often are where stormwater wetlands are sited, a stormwater wetland is often the most efficient practice available for pollution removal. Figure 1 (page 2) highlights several wetlands that NCSU researchers have monitored.

INTERNAL WETLAND ZONES

Figure 2 (page 2) illustrates a stormwater wetland design, and Figure 3 (page 3) depicts a cross-section of the wetland's internal topography by zone. The internal topography of a stormwater wetland can be divided into five zones: deep pools, transitions between deep and shallow water, shallow water, temporary inundation areas, and the upper bank that ties the wetland into its

NC STATE UNIVERSITY
A&T STATE UNIVERSITY
COOPERATIVE EXTENSION
Helping People Put Knowledge to Work

Figure 1. Four N.C. stormwater wetlands that have been monitored with published results: (A) Smithfield Selma High School in Johnston County, (B) Shade Valley Elementary School in Charlotte, (C) Chowan Golf Course in Edenton, and (D) UNC-Asheville in Buncombe County.

surroundings. Each zone supports different vegetation and serves a particular purpose. By incorporating all these zones in a single wetland, the designer creates a system that dissipates stormwater flow energy by distributing that flow over the entire wetland, multiple and unique zones for pollutant treatment, a relatively diverse ecosystem for wetland plants and animals, and an aesthetically pleasing addition to the local landscape.

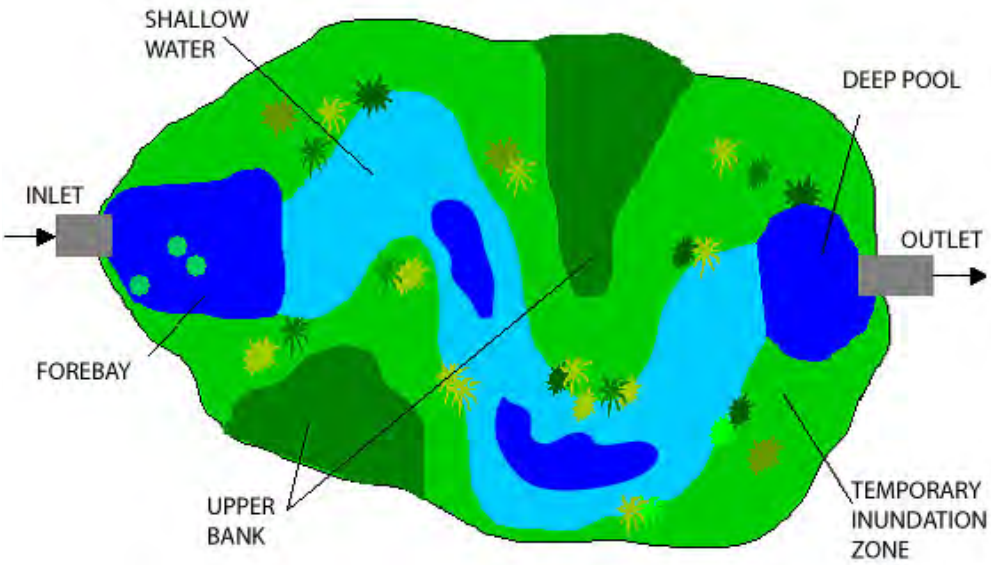

Figure 2. Plan view of a stormwater wetland

Deep Pools—Zone I

Deep pools serve several functions in a stormwater wetland. They dissipate flow energy, trap the sediment coming in with stormwater, and provide an anaerobic environment for enhanced nitrate treatment. They also provide additional water storage that increases both infiltration and evaporation, thereby reducing outflow volumes in locations where water tables are low. Deep pools also provide refuge for aquatic organisms during dry periods.

The deep pool is an important component of a mosquito-resistant stormwater wetland because it provides year-round habitat for mosquito predators

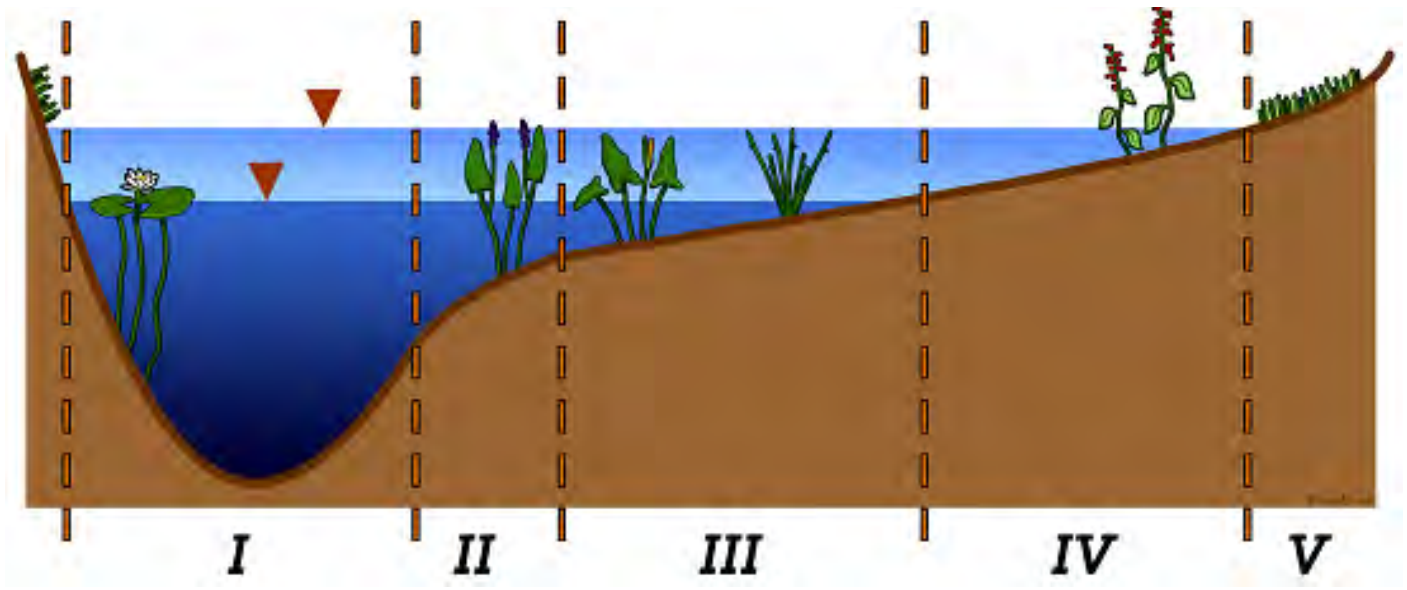

Figure 3. Interior wetland zones: (I) Deep Pool, (II) Transition, (III) Shallow Water, (IV) Temporary Inundation, and (V) Upper Bank

Figure 4. Small deep pool with water lilies

that require water to thrive. Several deep pools should pockmark a stormwater wetland to allow easier predator travel from the deep pools to all parts of the stormwater wetland and thus easier access to mosquito habitats. Figure 4 shows a small deep pool.

Per some local codes, wetlands with deep pools may require fencing along their perimeter because of depth. The bottom elevation of a deep pool should be at least 18 inches deeper than the designed water elevation at *normal pool* the water elevation within the wetland after complete drawdown following a storm event. The depth of the deep pool should be 30 inches, if possible. Because deep pools shelter aquatic organisms, they must be deep enough to retain water during a drought.

A four-week drought in the summer can be used to calculate a maximum pool depth to ensure year-round water in the pools. A month without rainfall is extremely rare in the humid Southeast. For example, from July 2003 through June 2007, the N.C. Climate Center recorded less than 1.0 inch of rainfall at Raleigh-Durham Airport in only one month: September 2005 with 0.83 inch (http://www.nc-climate.ncsu.edu/cronos/). Remember that even a relatively small storm event (such as 0.50 inch) can contribute 3 to 6 inches of water depth to a stormwater wetland.

Assuming a four-week summer drought, it is reasonable and conservative to expect up to 10 inches of water loss due to evapotranspiration (evaporation plus transpiration by the wetland plants). If the wetland does not intersect shallow groundwater and is therefore *perched* an infiltration loss also may occur. This loss will generally be low since perched stormwater wetlands should be sited in areas that have very low infiltration rates. These rates may vary from 0.01 in/hr (recommended) to 0.05 in/hr. Assuming a water loss rate of 0.01 in/hr, approximately 0.25 in/day will exit the wetland due to infiltration. In a week, slightly less than 2 inches would exit the wetland, so it is reasonable to estimate 8 inches of water loss during a one-month drought. A simple water balance equation (equation 1, page 4) can be used to determine the minimum depth necessary for deep pools.

The initial deep pool into which runoff enters the wetland is called the *forebay*. The forebay has two purposes: (1) to dissipate the entering runoff's energy and (2) provide a storage zone where gross solids and sediment will settle. The forebay's size should be approximately 10 to 15 percent of the total wetland surface area. A study conducted by N.C. State in 2004 and 2005 confirmed this to be a reasonable sizing

standard. Once a forebay fills with gross solids and sediment, the collected material must be removed. This is reviewed in *Stormwater Wetland and Wet Pond Maintenance* (AGW-588-7).

Deep pools (including the forebay) should occupy between 20 and 25 percent of the total wetland surface area.

EQUATION 1

$DP = RF_M + EF + WS/WL - ET - INF - RES$

Where

DP = Depth of pool (inches)

RF_M = Monthly rainfall during a drought (inches)

EF = Fraction of rainfall that enters stormwater wetland from the watershed (0.20 to 0.25 estimate)

WS/WL = Ratio of watershed area to wetland surface area

ET = Monthly evapotranspiration water loss (inches)

INF = Monthly infiltration water loss (inches)

RES = Reservoir of water for a factor of safety (inches)

EXAMPLE

During July, 1.0 inch of rain fell. Of this rainfall, 20 percent entered the stormwater wetland (RF = 0.2). The watershed-to-wetland surface area ratio (WS/WL) is 20. ET losses are 8 inches — probably a conservative estimate. Exact ET losses due to stormwater wetlands have yet to be determined. (Monthly evapotranspiration loss can be found at the State Climate Office Web site, part of the N.C. ECONET monitoring network). The infiltration rate is 0.01 in/hr. The designer would like to keep 6 inches of water in reserve as a factor of safety.

Calculate the amount that will infiltrate from the wetland:

INF = (0.01 in/hr × 24 hr/d × 31 d) = 7.4 in

With this information, the depth of the deep pool should be:

DP = 1 in × 0.20 × 20 – 7.4 in – 8 in – 6 in = –17.4 in

Therefore, the deep pool zone should be a minimum of 17 to 18 inches deeper than the normal pool level.

Deep to Shallow Water Transitions—Zone II

A stormwater wetland should be designed with two major internal regions: the deep pools discussed above and a shallow water zone. The average depth of each is quite different (18 to 30 inches for deep pools and 2 to 4 inches for shallow water). These deep and shallow zones should be connected with a maximum slope of 1.5:1 (1.5 horizontal feet per 1 vertical foot of elevation change). Slopes steeper than this are not recommended inside the wetland to ensure soil stability and safety.

The *transition zone* consists of the gentle slopes that connect the deep pools and shallow water. Only a few plants can tolerate the transition zone's depth. Those that do survive enhance the wetland's effectiveness because they support both nitrification and denitrification. The transition zone tends to occupy the smallest amount of surface area in a stormwater wetland. The water depth for this zone should be between 6 and 9 inches when the wetland is at normal pool. Note that this zone incorporates *all* depths between the deep pools (18 inches) and shallow water zone (4 inches).

Shallow Water—Zone III

Shallow water zones also retain water following drawdown of the wetland after a storm event. At low flows, water entering the wetland should follow the course of the shallow water zone. During extended drought periods, shallow zones will eventually become dry. Until they dry, they form connections between deep pools that allow aquatic passage for small fish, amphibians, and invertebrates. Shallow zones are important in pollutant treatment because they are better oxygenated than deep pools and support nutrient transformations such as nitrification.

One of the most important revisions to earlier stormwater wetland design guidance is the recommended depth of the shallow water zone. *Designing Stormwater Wetlands for Small Watersheds* (AG-588-2) specified a depth of 6 to 12 inches. Since that guidance was published in 2000, researchers have observed that most wetland plants could not tolerate water this deep for extended periods. To obtain a wider range of plant life, thus avoiding a vegetation monoculture, we now recommend average shallow water depths of 2 to 4 inches at normal pool.

One common concern among designers is the ability of shallow water plants to survive a drought. As Figure 5 shows, once established, shallow water

plants can tolerate being dry (not inundated) during drought periods. Remember that naturally occurring wetlands also become dry occasionally. In fact, wetting and drying cycles enhance a wetland's ability to treat many pollutants effectively. Even during droughts, soils in a wetland remain moist within a foot of the surface. As long as wetland plant roots can reach these moist soils, they will survive most droughts.

Figure 5. A stormwater wetland in Durham during the drought of 2002. Note the pickerelweed (a plant that usually flourishes in 3 to 6 inches of water) that is "high and dry."

Temporary Inundation—Zone IV

Formerly referred to as *shallow land*, the temporary inundation zone acts as an internal floodplain. It surrounds the channel of shallow water and extends to the wetland's lower bank. It is designed for complete inundation when any storm larger than the design water-quality event occurs in the watershed. This zone has no significant standing water several days after a storm. The elevation of the ground surface is above the invert of the low-flow drawdown, to be discussed later. At normal pool, the elevation of land above the waterline will range from 0 to (nominally) 12 inches. The actual vertical extent of the temporary inundation zone depends on the depth to which the designer wishes to store the water-quality volume (see the "Water Quality Volume" sidebar).

Like the shallow water zone, the temporary inundation zone allows a variety of vegetation to be grown, giving the wetland the potential to be a diverse ecosystem. The temporary inundation zone often includes a narrow strip of land that can be termed the *lower bank*. The lower bank is the part of a bank that is inundated when the water-quality volume is captured.

WATER QUALITY VOLUME

This term, often interchangeable with the term *first flush*, is the volume of water designed to be captured so that 90 percent of the annual stormwater pollutant load can be treated. It relies on the idea that most of the pollutants delivered to a stream or estuary come from many relatively small storms. Of approximately 110 storms that pass over Raleigh-Durham Airport annually, nearly 100 of them are less than or equal to 1.0 inch. Researchers believe that on a long-term basis, capturing all the water from a 1.0 to 1.5-inch storm event would allow for 90 percent of the annual pollutant load to be treated. Note that in this case, *treated* does not mean *removed*. The North Carolina Department of Environment and Natural Resources (NCDENR) has set the water quality volume to be that generated by a 1.0-inch storm for most of the state and 1.5 inches for the 20 coastal counties (including those counties bordering the Albemarle and Pamlico Sounds).

Upper Bank—Zone V

The upper bank consists of the upland area surrounding the stormwater wetland. The upper bank's surface area is not included as part of the wetland surface area, but it is necessary to tie the wetland topography back into the surrounding land. A wide variety of vegetation is able to survive in this zone, provided it can grow on slopes. The upper bank should not be sloped any steeper than 3:1, especially in sandy soils. (Designers may need to exceed this maximum slope recommendation in retrofit applications.) A 3:1 slope will minimize erosion and allow a reasonable grade for maintenance, such as mowing or pruning. Precautionary stabilization measures are discussed in a companion factsheet, *Stormwater Wetland Construction Guidance* (AG-588-13).

SELECTING VEGETATION

Since the publication of AG-588-2, researchers have refined the list of plants for stormwater wetlands. Many more species of wetland vegetation can flourish in non-stormwater wetlands than in stormwater wetlands. Most previous lists of plants recommended for stormwater wetlands were based on naturally occurring or constructed wastewater treatment wetlands. Experience and research indicates that much of the previously recommended vegetation does not tolerate the extreme conditions of a stormwater wetland.

Unlike naturally occurring wetlands and wastewater treatment wetlands, stormwater wetlands have relatively dramatic and frequent changes in water surface. A stormwater wetland's water depth measured from a point in the shallow water zone can vary from 3 to 15 inches and back to 3 inches in as few as three days.

Over a long term, many plants cannot handle the periodic water fluctuation (hydroperiod) unique to stormwater wetlands. Based upon observing approximately 20 stormwater wetlands across North Carolina that are at least two years old, researchers have identified a select group of plants to be reliably able to survive in stormwater wetlands. This list has been divided into two tiers. The plants listed in Tier 1 are those that have developed extensive colonies inside observed wetlands (Table 1). These are the most dominant species within a stormwater wetland. Tier 2 plants survive and can add color to a wetland, but rarely have outcompeted the plants listed as Tier 1 when establishing large colonies (Table 2). Several of the species listed in Tables 1 and 2 are depicted in Figure 6.

Cattails (*Typha* spp.) are conspicuously absent from both lists. Despite being a native species, cattails are well adapted to develop monocultures that shelter mosquitoes from their predators. In short, if a stormwater wetland is to be located near a population center, such as a commercial center parking lot or a residential neighborhood, keep cattail populations under control. If cattails colonize more than 15 percent of a stormwater wetland located near populated areas, remove the majority if not all of them. When stormwater wetlands are constructed in rural areas, such as along highways in eastern North Carolina, it is reasonable to allow cattail growth. Cattails tolerate relatively high pollutant loads and propagate easily.

See the extensive discussion of why cattails are discouraged in stormwater wetlands in *Mosquito Control for Stormwater Managers* (AGW-588-4). Methods of removing cattails are described in *Stormwater Wetland and Wet Pond Maintenance* (AGW-588-7).

Figure 6. Select herbaceous species that survive in stormwater wetlands: (A) woolgrass, (B) pickerelweed, (C) rose mallow, (D) cardinal flower, (E) Joe-pye weed

Table 1. Stormwater Wetland Vegetation — Tier 1. Research indicates these plants reliably colonize stormwater wetlands. They are listed in order of water tolerance, from most water tolerant to least.

Common Name	Scientific Name	Zone(s)	Comments
Fragrant water lily	*Nymphaea odorata*	I and II	Deepest fringe of Zone II only. Although this species is listed as native to North Carolina by the U. S. Department of Agriculture, some vegetation experts do not recommend its use.
Spatterdock	*Nuphar lutea*	I and II	Deepest fringe of Zone II only. Although this species is listed as native to North Carolina by the U. S. Department of Agriculture, some vegetation experts do not recommend its use.
Softstem bulrush	*Schoenoplectus tabernaemontani*	II and III	Former scientific name: *Scirpus validus*
Pickerelweed	*Pontedaria cordata*	II and III	Bright and showy purple-blue flowers
Broadleaf Arrowhead	*Sagittaria latifolia*	III	Broad leaves. White flowers in summer.
Bulltongue Arrowhead	*Sagittaria lancifolia*	III	White flowers in summer
Burreed or bur-reed	*Sparganium spamericanum*	III	Tolerates flowing water zones near inlets and outlets
Lizard's tail	*Saururus cernuus*	III and IV	Can dominate in drier years. Distinctive thin white flowers.
Woolgrass	*Scirpus cyperinus*	III and IV	Tall, brown seed heads in late summer. Makes a tall border.
Sedge	*Carex* spp.	III and IV	Many species available. Good initial colonizer.
Common rush	*Juncus* spp.	III and IV	Grows best at the water's edge. Near evergreen in the coastal plan and eastern piedmont.

Table 2. Stormwater Wetland Vegetation — Tier 2. Research indicates these plants survive often in stormwater wetlands and add color. They are listed in order of water tolerance, from the most water tolerant to the least.

Common Name	Scientific Name	Zone(s)	Comments
Water lotus (American lotus)	*Nelumbo lutea*	I, edge II	Protrudes from deep pools. Good for mountain wetlands. Some concern that this plant is too aggressive. Although this species is listed as native to North Carolina by the U. S. Department of Agriculture, some vegetation experts do not recommend its use.
Arrow arum	*Peltandra virginica*	III	Similar appearance to *Sagittaria*
Swamp milkweed	*Asclepias incarnata*	III and IV	Orange flowers in fall
Blue flag iris	*Iris virginica* or *versicolor*	III, IV edge	Showy blue (or other color) flowers in late spring. Grows at water's edge.
Cardinal flower	*Lobelia cardinalis*	IV	Red flowers in late summer
Hibiscus (rose mallow)	*Hibiscus moscheutos and H. grandiflorus*	IV	Showy white and red flowers in mid- to late summer
Swamp rose	*Rosa palustris*	IV	Off-white blooms in spring
Joe-pye weed	*Eupatorium purpureum*	IV and V	Purplish bloom in summer and fall

The denser the initial planting, the more quickly the vegetation will establish and the less likely invasive species of plants will dominate the stormwater wetland. For most of the species listed in Tables 1 and 2, the recommended planting density is one plant on 24-inch centers (or one plant per 4 square feet), if the stormwater wetland is to be colonized in one year. Planting herbaceous vegetation on 36-inch centers (one plant per 9 square feet) will tend to have the wetland fully colonized after two years. We do not recommend planting in densities of less than one plant per 9 square feet.

Several trees can survive in stormwater wetlands, including bald cypress (*Taxodium distichum*), river birch (*Betula nigra*), sycamore (*Platanus occidentalis*), and red maple (*Acer rubrum*). Clusters of trees should be avoided, however, due to their eventual harboring of mosquito larvae and pupae. A tree density of three to four trees per 10,000 square feet of wetland surface area is recommended. Because many trees will "volunteer" in a stormwater wetland (especially black willows, alders, and sweet gums), anyone responsible for wetland maintenance should be told which trees are desirable and which should be removed.

A large wetland may have a vegetated dam face. The dam face should be completely free of trees and shrubs, as discussed in *Stormwater Wetland and Wet Pond Maintenanc*e (AGW-588-7). The best vegetative cover for the dam face (and rear) is grass. If water is to flow over a grassed area at a velocity exceeding 4 feet per second, turf reinforcement matting will be needed.

A discussion of planting methods is found in *Stormwater Wetland Construction Guidance* (AG-588-13).

PROVIDING A GROWTH MEDIUM FOR WETLAND VEGETATION

As discussed earlier, it is important to avoid excessive seepage from the wetland. To prevent excessive exfiltration from wetlands, the in-situ soil is either tamped down or a clay supplement is added and tamped down into the stormwater wetland's base soil. If this compacted soil is not amended, it is difficult for wetland plants to spread their roots through it. For that reason, we strongly recommend that a layer of topsoil be stored or brought in during construction and placed over the compacted soil in the bottom of the wetland. The suggested thickness of the topsoil layer is 3 to 6 inches, with a 4-inch minimum preferred (Figure 7).

Figure 7. Topsoil being replaced on the wetland fringe of a wet pond

Adding topsoil back to the wetland provides organic matter and an easy path for root growth during the initial stage of the stormwater wetland's life. Recent research at N.C. State on small-scale wetlands revealed increased performance of nitrate treatment when poor soils were amended with organic matter (see Burchell et al. in the Resources section). The topsoil is especially important in the shallow water (III) and temporary inundation (IV) zones.

BYPASS OR NOT?

Sometimes when a stormwater wetland is a retrofit, not enough land is available to properly size it. In these situations, the wetland may need to have runoff bypass it rather than flow directly through it. When a substantially undersized wetland does not have a bypass, too much flow can enter the wetland, risking a "blow-out" of vegetation. A good rule of thumb is this: If the available area for a stormwater wetland is at least 67 percent of the required design surface area, the wetland should be constructed in the ephemeral channel *without* a bypass. If the available space is less than 67 percent of what is needed for a full-sized stormwater wetland, a bypass should be constructed.

OUTLET CONFIGURATION

A stormwater wetland outlet has three functions: (1) detain the water quality volume for treatment inside the wetland, (2) safely pass large events that exceed the water quality storm, and (3) allow for maintenance by lowering the pool elevation inside the wetland. *Designing Stormwater Wetlands for Small Watersheds* (AG-588-2) explains how to achieve each function. Since its publication, we have discovered

many design nuances that affect the outlet structure.

Stormwater wetlands must retain stormwater for a minimum of 48 hours. To achieve this, a drawdown hole, or orifice is used to slowly release the temporarily captured runoff. For stormwater wetlands serving watersheds of 50 acres or less, the typical orifice is quite small, with a diameter often measuring less than 2 inches, leaving it prone to clog (see AGW-588-7 for more information). Take these preventive design measures to limit the potential for clogging (Figure 8):

1. Include a trash rack around the orifice as part of all designs.
2. Draw water from lower portions of the deep pool by submerging the orifice inlet. This keeps floating debris from clogging the orifice.
3. Incorporate elements of a *flashboard riser*, a technology borrowed from controlled drainage systems in eastern North Carolina.

OFF-LINE VERSUS IN-LINE STORMWATER WETLANDS

Due to the regulatory difficulties of constructing stormwater wetlands in streams, many stormwater wetlands are constructed *off-line*. That is, water is diverted from the stream to the wetland and then released from the outlet of the wetland back to the stream. Sometimes off-line wetlands are the only possible practice from a retrofit perspective. Researchers have observed that off-line wetlands tend to be more difficult to design, and they perform more poorly than wetlands constructed in-line with an ephemeral stream.

Off-line wetlands tend to be sited in floodplains, which creates a challenge when flooding occurs. If the stream floods, it can force water to pond in the wetland for long periods of time. This is particularly true when the wetland is installed near a major river (such as the Cape Fear, Neuse, or Yadkin). When one of these rivers floods, floodwaters could inundate the stormwater wetland for weeks, killing most of the wetland vegetation.

Conversely, during dry periods when only small storms fall on a watershed, it is highly possible that too little (or no) water will enter the off-line stormwater wetland. Flow into off-line wetlands is often triggered by storms exceeding 0.50 inches. If a stormwater wetland is built in-line with a channel, any storm that produces runoff will provide water to the wetland.

Figure 8. Downturned pipe on an orifice (A) and a trash rack in place around an orifice (B)

A flashboard riser is an effective outlet (Figure 9, page 10) that has been adopted into several stormwater wetland designs in the past eight years. It is flexible. Very few pre-cast concrete structures have the appropriate flexibility.The riser functions by placing tongue and groove boards (Figure 10, page 10) on-end to form an adjustable weir. The orifice is simply drilled through one of the boards, to which a trash rack or downturn pipe (or both) can be attached.

The flashboard riser is traditionally a corrugated aluminum pipe cut in half with sleeves (channels) at either end into which the wooden boards are placed. This allows for adjustable water elevations. The type of lumber used should be an environmentally friendly marine grade. Some variations of flashboard structures employ materials other than wood (Figure 11, page 10). These materials are usually more expensive, but they may be easier to use or have a longer life. No matter the outlet type, install anti-seep collars to prevent piping.

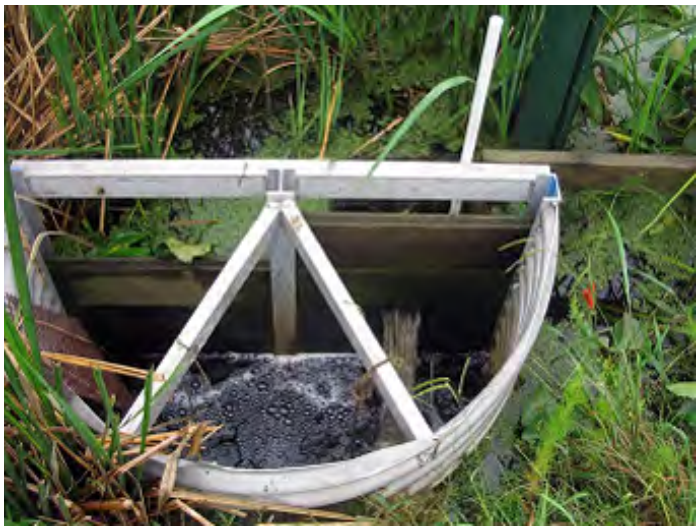

Figure 9. An outlet employing the traditional flashboard riser

Figure 10. Small flashboard riser boards are stacked tongue-in-groove.

A schematic of a flashboard riser is found on the BAE Stormwater Engineering Group Web site: http://www.bae.ncsu.edu/stormwater/specs.htm.

A wetland manager can adjust the water level by adding or removing boards from the riser, or even by replacing a 2- by 6-inch board with a 2-by-4. The adjustable outlet allows a designer to compensate for potentially small (but important) grading mistakes inside the wetland. This is particularly important for the shallow water zone, which should be 2 to 4 inches deep. Being a couple of inches higher or lower than the target elevation can significantly affect the survival of desired vegetation.

When the wetland needs to be drained for maintenance purposes (for example, to plant the deep pools), a corresponding number of boards can be removed. The flashboards must be able to empty water from every wetland zone but Zone I, the deep pool zone. High flows can overtop the highest board, which acts as a weir. In short, a flashboard riser is able to meet all three functions of an outlet.

Finally, the adjustable water level concept is particularly useful during plant establishment. Research shows that less fluctuation in the water level during the initial growing season allows for a higher plant survival rate. The maximum fluctuation should be kept at 4 to 6 inches during the initial growing season, even if the outlet is designed to retain 12 inches of water during a water-quality event.

Figure 11. Adjustable outlet structures are modifications of the flashboard riser.

WETLAND DESIGN IN TROUT WATERS

Stormwater BMPs for Trout Waters (AGW-588-10), details several design guidelines associated with mountain stormwater wetlands:

Select vegetation that does not float on the water. Plants that float, such as spatterdock and fragrant water lilies, trap heat on the water's surface. The only deep pool plant that is effective in the mountains is the American lotus because it does not float.

Draw water from the bottom of the deep pool adjacent to the outlet structure. This releases the coldest water in the wetland to a receiving stream, usually a trout-sensitive water.

SUMMARY

Stormwater wetlands have become one of the more common stormwater treatment practices in North Carolina because they can reduce pollutant loads. Since initial design standards were released in the late 1990s, new design guidelines have been developed that impact internal topography, wetland plant selection and establishment, and outlet configuration.

RESOURCES

Related Fact sheets

in the Urban Waterways series (AG-588), North Carolina Cooperative Extension Service, N.C. State University:

Hunt, W. F. and B. A. Doll. 2000. *Designing Stormwater Wetlands for Small Watersheds* (AG-588-2). Online: http://www.bae.ncsu.edu/stormwater/PublicationFiles/SWwetlands2000.pdf

Hunt, W. F., C. S. Apperson, W. G. Lord, and S. G. Kennedy. 2005. *Mosquito Control for Stormwater Facilities* (AGW-588-4). Online: http://www.bae.ncsu.edu/stormwater/PublicationFiles/Mosquitoes2005.pdf

Hunt, W. F. and W.G. Lord. 2006. *Stormwater Wetland and Wet Pond Maintenance* (AGW-588-7). Online: http://www.bae.ncsu.edu/stormwater/PublicationFiles/WetlandMaintenance2006.pdf

Jones, M. P. and W. F. Hunt. 2007. *Stormwater BMPs for Trout Waters* (AGW-588-10). Online: http://www.bae.ncsu.edu/stormwater/PublicationFiles/BMPsColdTemps2007.pdf

Burchell, M. R., W. F. Hunt, J. D. Wright, and K. L. Bass. 2007. Stormwater Wetland Construction Guidance (AG-588-13). Available in May 2008.

Related Web Sites

BAE Stormwater Team Web site:
http://www.bae.ncsu.edu/stormwater
N.C. State University's clearinghouse for stormwater BMP guidance, including design, construction, and maintenance of stormwater wetlands, bioretention, permeable pavements, water harvesting, and level spreaders.

USDA-NRCS Wetland Plant Database:
http://plants.usda.gov
National list of plants able to live (and not) in wetlands. Contains pictures, states whether a species is native, and provides other wetland plant details.

State Climate Office of North Carolina:
http://www.nc-climate.ncsu.edu
Provides climate data, such as rainfall and evapotranspiration amounts, for cities across North Carolina.

Other Resources

Burchell, M. R., R. W. Skaggs, C. R. Lee, S. Broome, G. M. Chescheir, and J. Osborne. 2007. Substrate organic matter to improve nitrate removal in surface-flow constructed wetlands. *Journal of Environmental Quality* 36:194-207.

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Appendix F: Xeriscape Planting

The City of Lethbridge

Xeriscape Planting Report

Capability

The City of Lethbridge

Draft Xeriscape Planting Report

Prepared by:

AECOM

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Project Number:

6011294

Date:

December, 2009

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This Statement of Qualifications and Limitations is attached to and forms part of the Report.

200 – 6807 Railway Street
Calgary, AB, Canada T2H 2V6
www.aecom.com

December, 2009

Ryan Carriere
Parks Planning Manager
City of Lethbridge – Infrastructure Services
910 4th Avenue S.
Lethbridge, AB T1J 0P6

Dear Mr. Carriere:

Please find enclosed the xeriscape report for your review. The report consists of drawings showing plan, elevation and section previously discussed and three plant lists. The plant lists consist of a master plant list, a xeriscape plant list and a reduced plant list suitable for medians.

If you have any questions or comments about the attached items please feel free to contact me.

Project No: **6011294**

Regarding: **Xeriscape Planting Report**

Sincerely,
AECOM Canada Ltd.

Gene Webber, ASLA,
Manager Landscape Architecture
Gene.webber@aecom.com

PW:gw
Encl.
cc:

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Revision Log

Revision #	Revised By	Date	Issue / Revision Description
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2	PSW	Dec. 23, 2009	Issued for Review

AECOM Signatures

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Landscape Architect

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Gene Webber, ASLA
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Appendix A. Median, Boulevard & Round-about Plant List
Appendix B. Xeriscape Plant List
Appendix C. Master Plant List

1. Xeriscape Planting Report

1.1 Introduction

The purpose of this report is to show graphic examples of landscape typologies for the City of Lethbridge and to list the type of plant material that can be used in those situations. Consideration is given to the local climate and the desire of the City to reduce its maintenance and irrigation costs and impacts for its landscaped property. With this in mind there have been plant lists developed for the City of Lethbridge and specific plant lists which focus on more drought tolerant plants suitable for xeriscaped areas. There will be some opportunity for manicured landscapes and areas which are subject to increased moisture due to topographical conditions or deliberate rainwater use as a component of LID strategies. Because of this is also a list which includes plants which are less suitable to xeriscape landscapes and require more moisture.

Consideration has also been given to using concepts of Crime Prevention Through Environmental Design (CPTED) in the landscaped area to make spaces safer for the users. The concept of natural surveillance is a focus here and plants are used which the typical citizen can either see over (height restricted to 1m), or under (branching height above 1.5 m) to ensure site lines can be preserved if necessary. All the plant lists have a column which shows whether or not these plants will allow for important sight lines.

1.2 Rock Mulch Coarse Sand Mulch & Bark Mulch

Rock mulch is commonly used in xeriscape plantings and arid environments. It is commonly understood to prevent moisture transpiration better than bark mulch and it does not catch fire the way bark mulch can in dry conditions. It also does not decompose and turn to soil the way bark mulch does. Rock mulch used in contrasting diameters and colours does provide an attractive appearance and lends itself to being an attractive landscape element by itself - much more so than bark mulch. This also allows less plant use and the artful placement of boulders can result in significant artistic effect. The use of coarse sand interspersed within a rock mulch composition creates a pleasing dry stream effect with its own aesthetic. Unl ke bark mulch, rock mulch does not blow away in the wind.

Rock mulch is applied both with and without root barrier fabrics. The use of root barrier fabrics tends to reduce maintenance in the initial 2-3 years from installation but as sediments and windblown soils accumulate in the crevices anti-germinant sprays are typically required. Root barrier fabrics are somewhat troublesome in regard to irrigation maintenance and add significant upfront costs. Occasional wash-off with hydrant or truck water can reduce soil accumulation. These same factors apply to bark mulch installations as well, although bark mulch is typically renewed through top dressing. Rock mulch will, however, absorb and radiate heat and using it with particularly soft or sensitive plants and adjacent to seating areas is not advised. Its use in shady environments and areas such as medians and other transiently populated areas will result in less issues of this sort.

Coarse sand mulch should be screened sand greater than 250 micron size or crushed rock smaller than 5 mm. The sand mulch has similar affects for plants as rock mulch. The water loss due to evaporation is reduced and soil erosion from wind is also reduced with sand mulch. The sand mulch helps suppress the development of weeds and reflects sunlight onto the plants. Unlike rock mulch, sand will be more easily eroded by storms, but it still can be used effectively and can be combined with rock mulch or bark for more interesting designs in the planting beds.

1.3 Irrigation

The provision of drip irrigation in all planting areas is advised for initial plant establishment and for years of lower than normal precipitation. The provision of back-up drip irrigation will allow the City to preserve its investment in plants during installation in unusually dry conditions.

In addition to traditional irrigation techniques, The City of Lethbridge can take advantage of rainfall events for irrigation of some plant material. The Lethbridge climate, while statistically semi-arid, does have major runoff events and sufficient water holding capacity in the soil to support a "passive stormwater irrigation" approach such as the creation of rain gardens or bioswales. Such an approach has the added benefit of inducing deeper rooting which can improve plant vigour and resistance to hot weather and chinooks. This approach also favours the use of many water demanding plants included in the appended "Master Plant List" that would not be feasible for arid xeriscape plantings.

1.4 Mycorrhizal Fungi

The use of commercial mycorrhizal fungal spores as a supplement to augment soil around new plantings is an encouraging development. Healthy soils have a community of fungi which live in a symbiotic relationship with the plants at the root zone and strongly promote root development. The fungi aid the plant in the uptake of water and nutrients, but the typical human altered soil and dry-land areas frequently lack a sufficient amount of fungi to benefit the plants. During plant establishment and during Lethbridge's dry periods, water uptake is critical for plants so it is recommended that the City adopt a requirement for mycorrhizal supplements in its planting specifications to aid in root development, water uptake and plant survival in the constructed landscape.

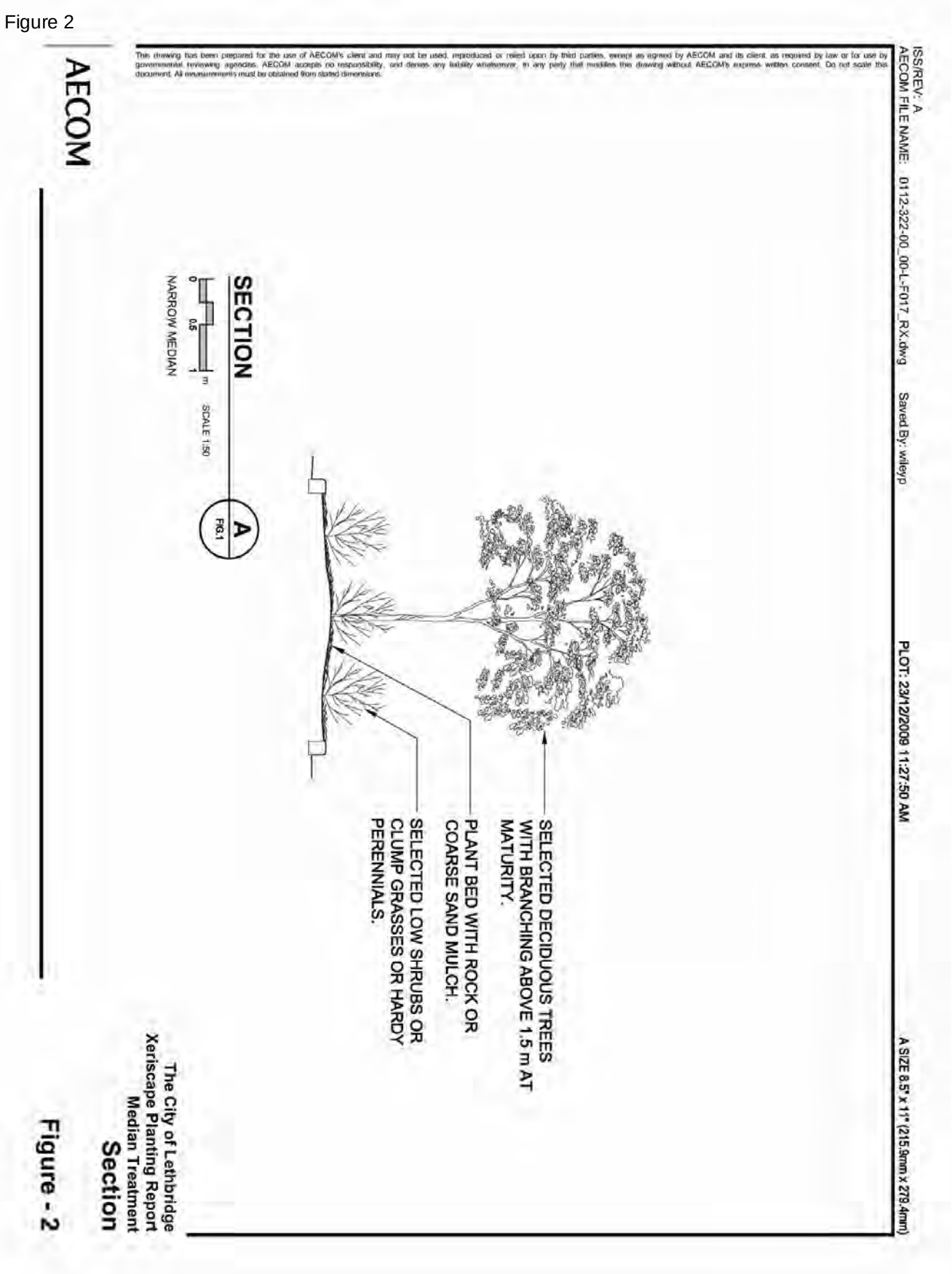
1.5 Soil Conditions

Rooting behaviour and consequent plant vigour can be strongly affected by soil conditions. Generally a permeable / root growth zone of at least 400mm depth is desirable and 600mm depth is preferable. The lower 2/3 portion of this zone does not need to be highly fertile but should not be barren sand or silt. The interface between this soil and the subsoil should be rough so that some root penetration into the subsoil is possible. It is preferable for the bottom of the rootballs of large trees to be within the subgrade, leading to greater wind resistance.

Figure - 1

Figure 1

Figure 2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AECOM
SECTION
A
FIG.1
0
0.5
1
m
SCALE 1:50
NARROW MEDIAN
SELECTED DECIDUOUS TREES WITH BRANCHING ABOVE 1.5 m AT MATURITY.
PLANT BED WITH ROCK OR COARSE SAND MULCH.
SELECTED LOW SHRUBS OR CLUMP GRASSES OR HARDY PERENNIALS.
The City of Lethbridge
Xeriscape Planting Report
Median Treatment
Section
Figure - 2

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SELECTED DECIDUOUS TREES
(WITH BRANCHING ABOVE 1.5 m WHEN MATURE)
SELECTED LOW SHRUBS, CLUMP GRASSES OR
HARDY PERENNIALS
ROCK OR COARSE SAND MULCH
(ENTIRE MEDIAN IS PLANT BED)
A
FIG. 4
MEDIAN TREATMENT
0 1 2 m SCALE 1:100
WIDE MEDIAN
The City of Lethbridge
Xeriscape Planting Report
Median Treatment
AECOM
Figure - 3

Figure 3

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SELECTED DECIDUOUS TREES WITH BRANCHING ABOVE 1.5 m AT MATURITY.
PLANTING BED WITH ROCK OR COARSE SAND MULCH.
SELECTED LOW SHRUBS OR CLUMP GRASSES OR HARDY PERENNIALS.
SECTION A FIG.3
SCALE 1:50
0 0.5 1 m
WIDE MEDIAN
AECOM
The City of Lethbridge
Xeriscape Planting Report
Median Treatment
Section
Figure - 4

Figure 4

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SELECTED LOW SHRUBS OR CLUMP GRASSES
SELECTED SHADE TREES
RIVER ROCKS
COARSE SAND OR ROCK MULCH
(ENTIRE MEDIAN IS PLANTING BED)
A
FIG. 7
NOTE: COARSE SAND MULCH TO BE SCREENED
SAND GREATER THAN 250 MICRON SIZE OR FINE
CRUSHED ROCK LESS THAN 5 mm DIAMETER.
MEDIAN TREATMENT
0 1 2 m SCALE 1:100
RIVER ROCK
CROSS BANDED PATTERN
The City of Lethbridge
Xeriscape Planting Report
Median Treatment
AECOM
Figure - 5

Figure 5

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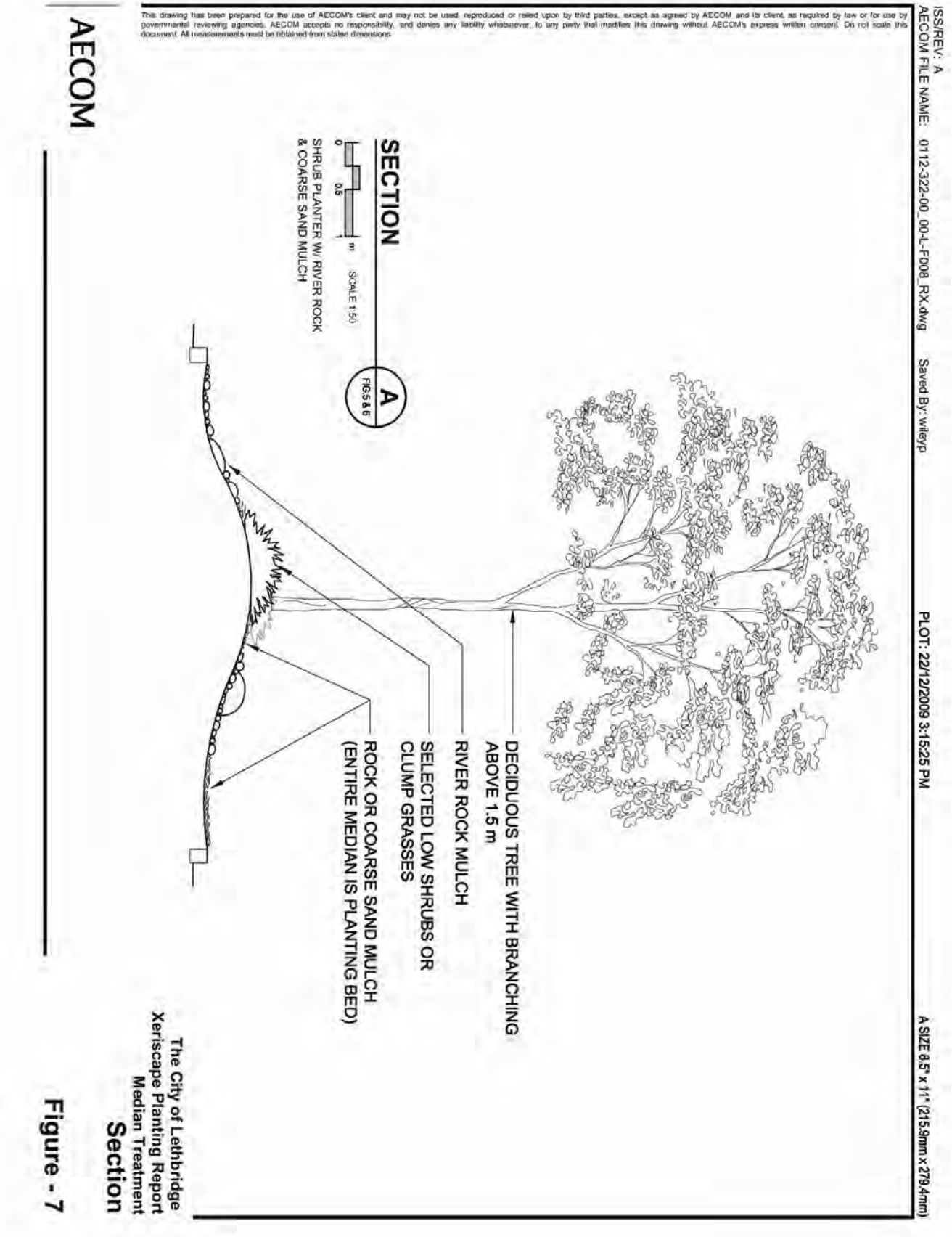
SELECTED SHADE TREES
RIVER ROCK MULCH & BOULDERS
ROCK OR COARSE SAND MULCH
(ENTIRE MEDIAN IS PLANTING BED)
SELECTED LOW SHRUBS OR CLUMP GRASSES
A
FIG. 7
NOTE: COARSE SAND MULCH TO BE SCREENED
SAND GREATER THAN 250 MICRON SIZE OR FINE
CRUSHED ROCK LESS THAN 5 mm DIAMETER.
MEDIAN TREATMENT
0 1 2 m SCALE 1:100
RIVER ROCK
MEANDER PATTERN
The City of Lethbridge
Xeriscape Planting Report
Median Treatment
AECOM
Figure - 6

Figure 6

Figure 7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ISS/REV: A
AECOM FILE NAME: 0112-322-00_00-L-F008_RX.dwg
Saved By: willeyp
PLOT: 22/12/2009 3:15:25 PM
A SIZE 8.5" x 11" (215.9mm x 279.4mm)
SECTION
A
FIGS 5 & 6
0
0.5
m
SCALE 1:50
SHRUB PLANTER W/ RIVER ROCK & COARSE SAND MULCH
DECIDUOUS TREE WITH BRANCHING ABOVE 1.5 m
RIVER ROCK MULCH
SELECTED LOW SHRUBS OR CLUMP GRASSES
ROCK OR COARSE SAND MULCH (ENTIRE MEDIAN IS PLANTING BED)
The City of Lethbridge
Xeriscape Planting Report
Median Treatment
Section
Figure - 7
AECOM

AECOM

The City of Lethbridge
Xeriscape Planting Report
Boulevard Treatment

Figure - 8

Figure 8

Figure 9

ISS/REV: A
AECOM FILE NAME: 0112-322-00_00-L-F013_RX.dwg Saved By: wileyp PLOT: 22/12/2009 3:40:43 PM A SIZE 8.5" x 11" (215.9mm x 279.4mm)
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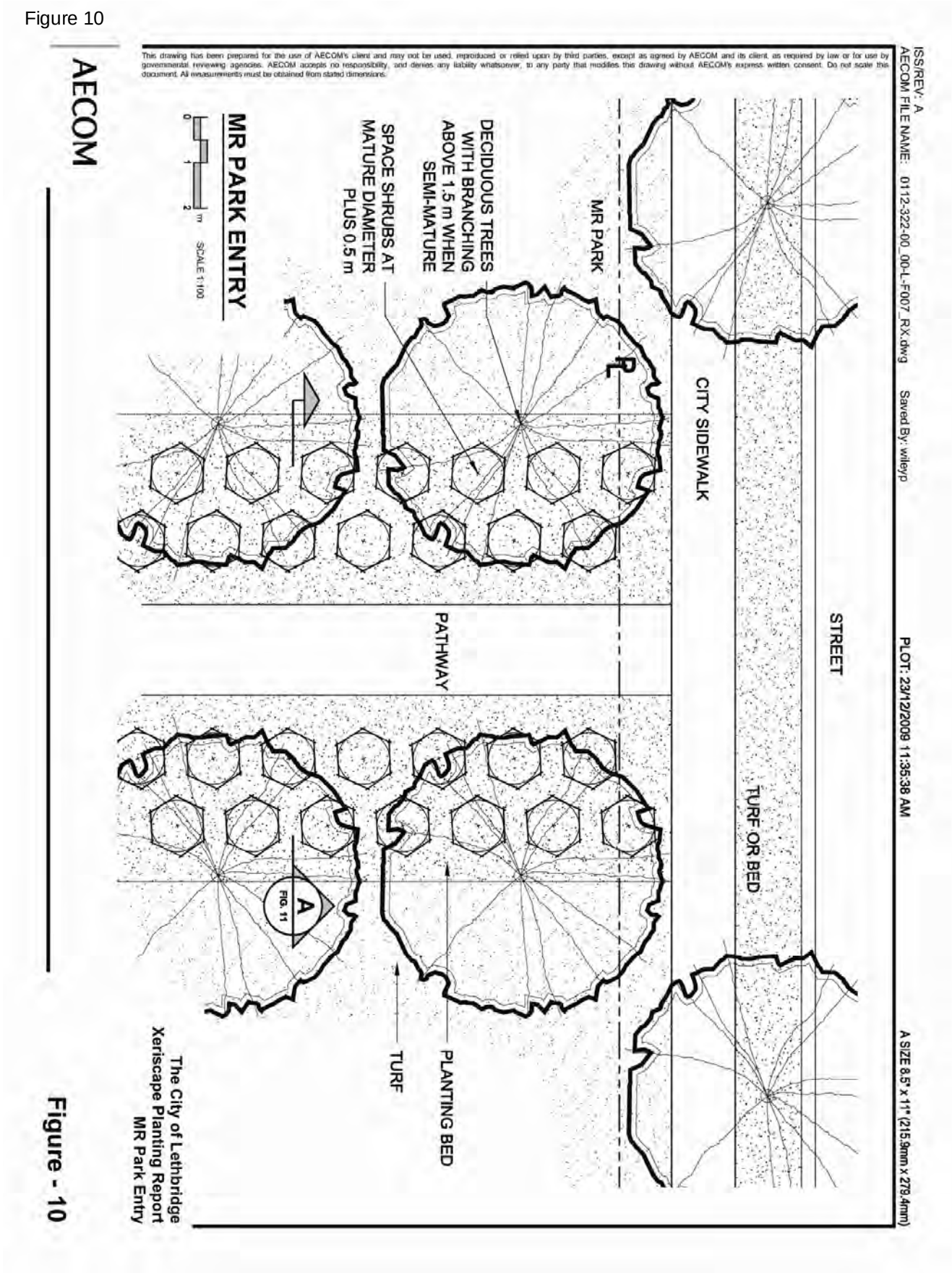
SELECTED SHADE OR FLOWERING TREES (ST)
SELECTED LOW DECIDUOUS OR EVERGREEN SHRUBS (ST)
SELECTED TUFT GRASSES OR HARDY PERENNIALS
ROCK OR COARSE SAND MULCH
STREET
PLANTING BED WITH ROCK MULCH
SELECTED LOW DECIDUOUS OR EVERGREEN SHRUBS PLANTED AT MATURE DIAMETER PLUS 0.3 m
NOTE: (ST) - SALT TOLERANT FOR ROADS WHERE SALT OR SALT/SAND MIX MAY BE USED.
WALK
PRIVATE PROPERTY
SECTION
A
FIG. 8
SCALE 1:100
m
0 1 2
AECOM
The City of Lethbridge
Xeriscape Planting Report
Boulevard Treatment
Section
Figure - 9

Figure 10


ISS/REV: A
AECOM FILE NAME: 0112-322-00_00-L-F007_RX.dwg Saved By: wileyp PLOT: 23/12/2009 11:35:38 AM A SIZE 8.5" x 11" (215.9mm x 279.4mm)
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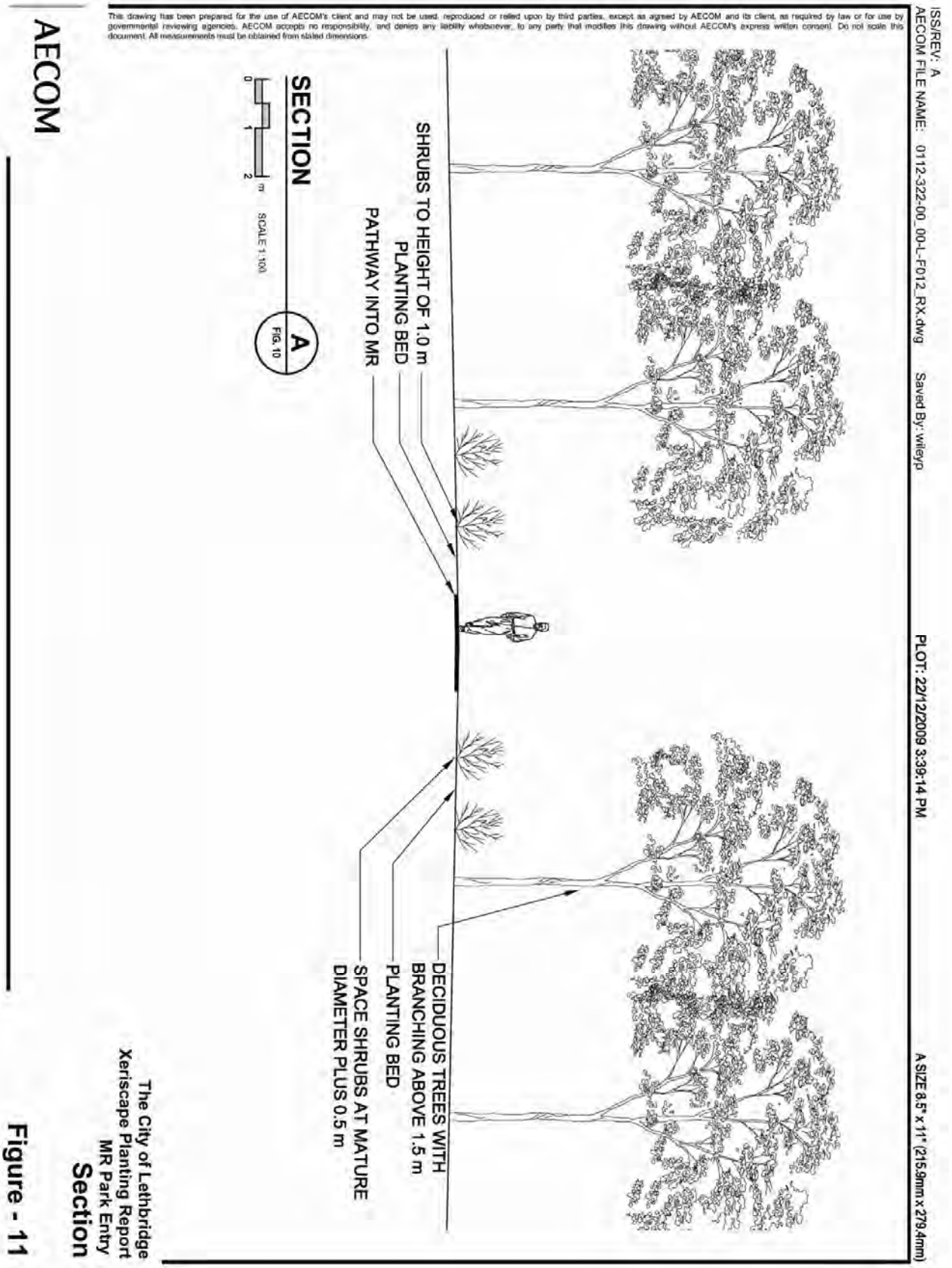
AECOM
MR PARK ENTRY
0 1 2 m SCALE 1:100
DECIDUOUS TREES WITH BRANCHING ABOVE 1.5 m WHEN SEMI-MATURE
SPACE SHRUBS AT MATURE DIAMETER PLUS 0.5 m
MR PARK
PL
CITY SIDEWALK
STREET
TURF OR BED
PATHWAY
A
FIG. 11
TURF
PLANTING BED
The City of Lethbridge
Xeriscape Planting Report
MR Park Entry
Figure - 10

Figure 11


ISS/REV: A
AECOM FILE NAME: 0112-322-00_00-L-F012_RX.dwg Saved By: wileyp PLOT: 22/12/2009 3:39:14 PM A SIZE 8.5" x 11" (215.9mm x 279.4mm)
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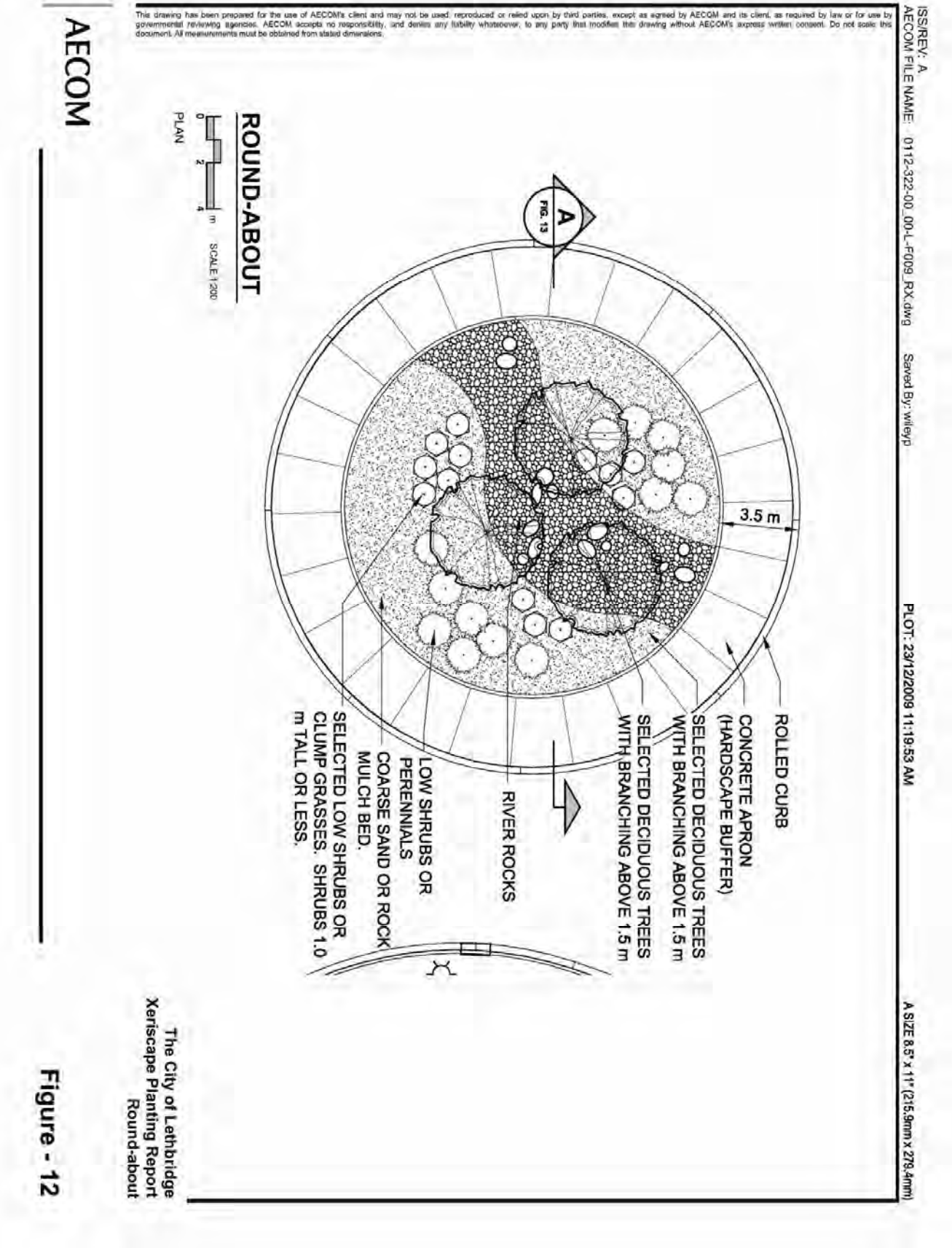
SECTION
A
FIG. 10
0 1 2 m SCALE 1:100
SHRUBS TO HEIGHT OF 1.0 m
PLANTING BED
PATHWAY INTO MR
DECIDUOUS TREES WITH BRANCHING ABOVE 1.5 m
PLANTING BED
SPACE SHRUBS AT MATURE DIAMETER PLUS 0.5 m
AECOM
The City of Lethbridge
Xeriscape Planting Report
MR Park Entry
Section
Figure - 11

Figure 12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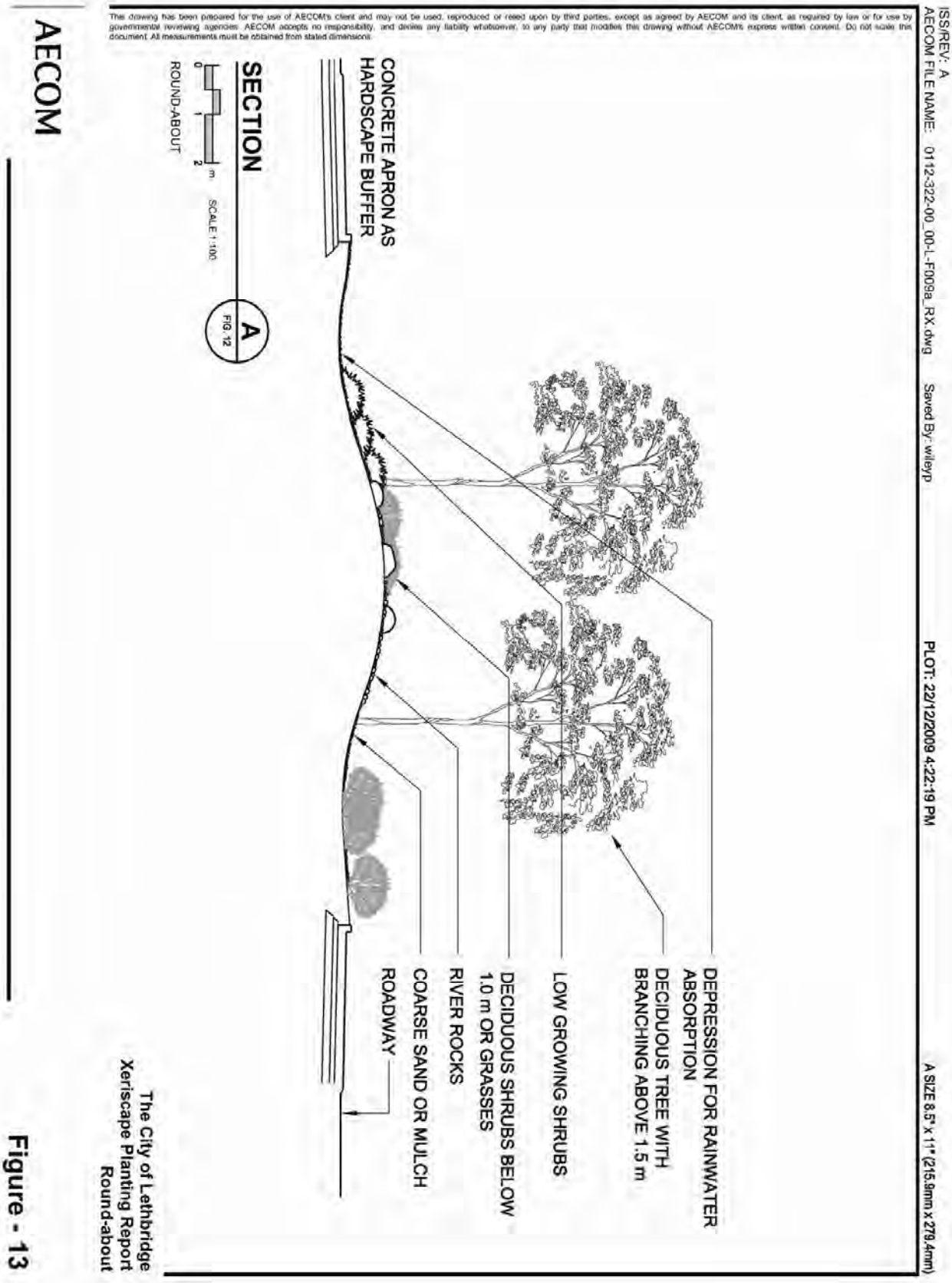
ISS/REV: A
AECOM FILE NAME: 0112-322-00_00-L-F009_RX.dwg Saved By: wileyp
PLOT: 23/12/2009 11:19:53 AM
A SIZE 8.5" x 11" (215.9mm x 279.4mm)
ROUND-ABOUT
PLAN
SCALE 1:200
A
FIG. 13
3.5 m
ROLLED CURB
CONCRETE APRON (HARDSCAPE BUFFER)
SELECTED DECIDUOUS TREES WITH BRANCHING ABOVE 1.5 m
SELECTED DECIDUOUS TREES WITH BRANCHING ABOVE 1.5 m
RIVER ROCKS
LOW SHRUBS OR PERENNIALS
COARSE SAND OR ROCK MULCH BED.
SELECTED LOW SHRUBS OR CLUMP GRASSES. SHRUBS 1.0 m TALL OR LESS.
AECOM
The City of Lethbridge
Xeriscape Planting Report
Round-about
Figure - 12

Figure 13


ISS/REV: A
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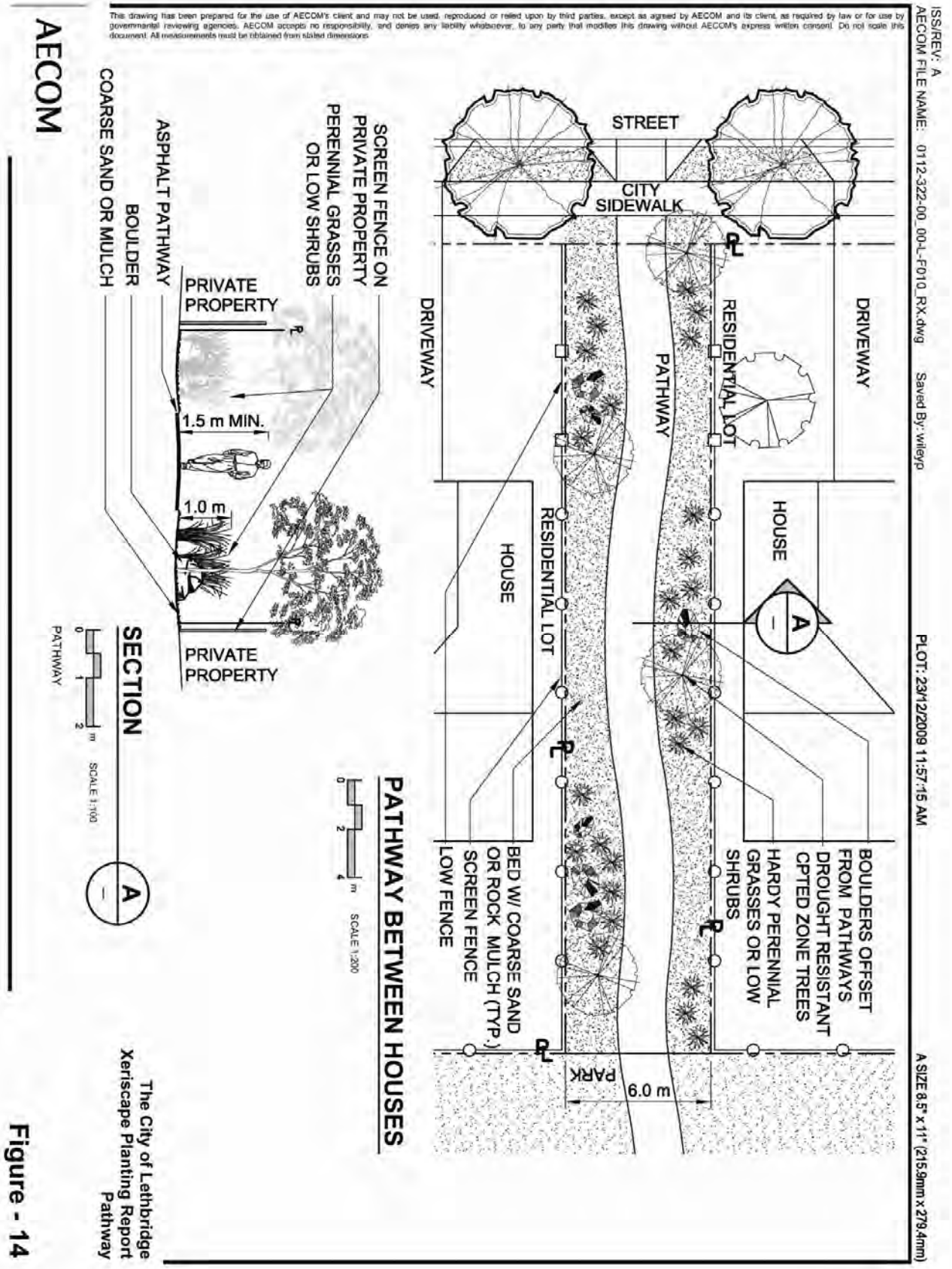
CONCRETE APRON AS HARDSCAPE BUFFER
DEPRESSION FOR RAINWATER ABSORPTION
DECIDUOUS TREE WITH BRANCHING ABOVE 1.5 m
LOW GROWING SHRUBS
DECIDUOUS SHRUBS BELOW 1.0 m OR GRASSES
RIVER ROCKS
COARSE SAND OR MULCH
ROADWAY
SECTION
A
FIG: 12
SCALE 1:100
0 1 2 m
ROUND-ABOUT
AECOM
The City of Lethbridge
Xeriscape Planting Report
Round-about
Figure - 13

Figure 14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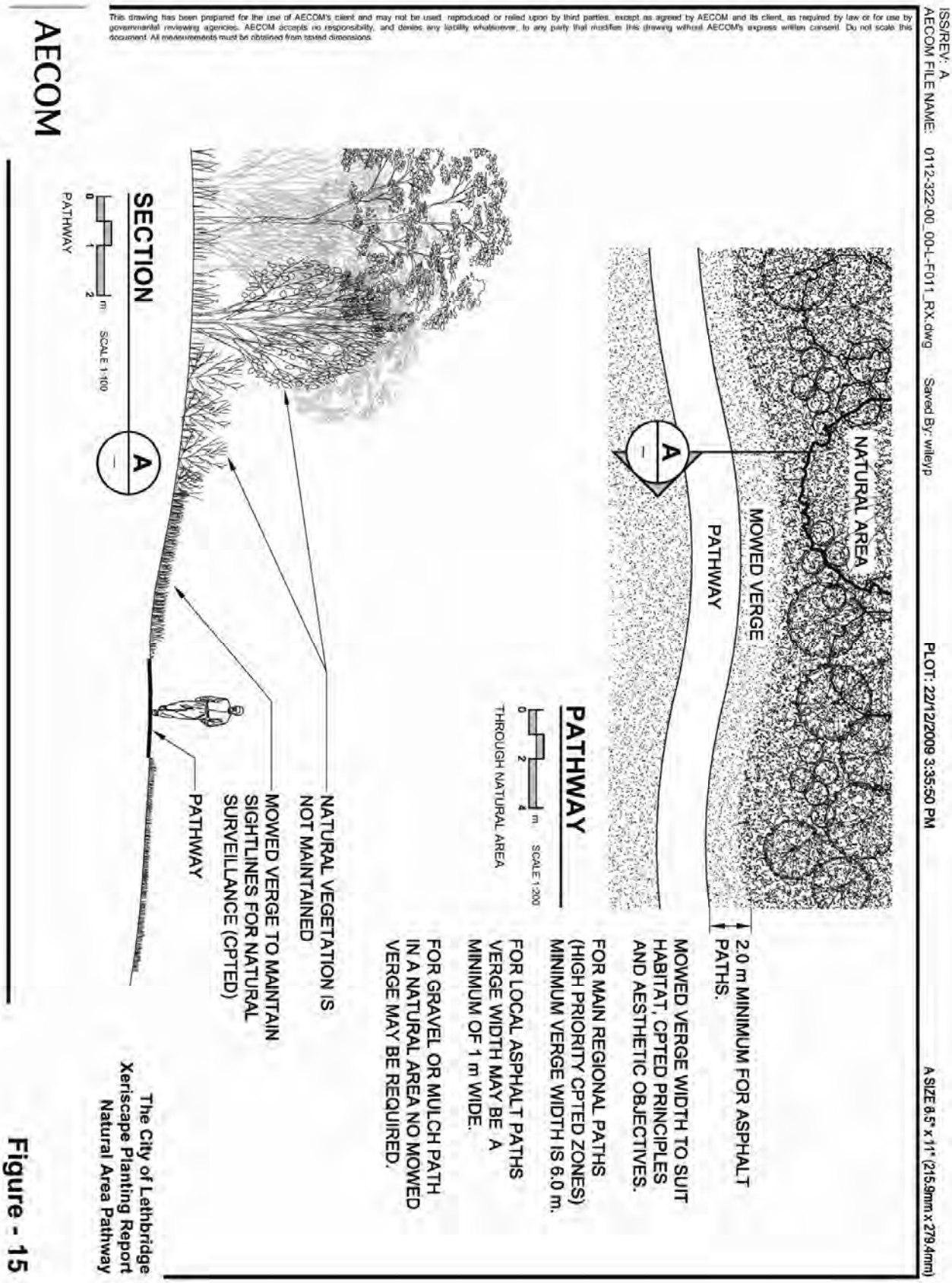
ISS/REV: A
AECOM FILE NAME: 0112-322-00_00-L-F010_RX.dwg Saved By: wileyp
PLOT: 23/12/2009 11:57:15 AM
A SIZE 8.5" x 11" (215.9mm x 279.4mm)
STREET
CITY SIDEWALK
DRIVEWAY
RESIDENTIAL LOT
PATHWAY
HOUSE
BOULDERS OFFSET FROM PATHWAYS
DROUGHT RESISTANT CPTED ZONE TREES
HARDY PERENNIAL GRASSES OR LOW SHRUBS
BED W/ COARSE SAND OR ROCK MULCH (TYP.)
SCREEN FENCE
LOW FENCE
PARK
6.0 m
PATHWAY BETWEEN HOUSES
SCALE 1:200
SCREEN FENCE ON PRIVATE PROPERTY
PERENNIAL GRASSES OR LOW SHRUBS
ASPHALT PATHWAY
BOULDER
COARSE SAND OR MULCH
PRIVATE PROPERTY
1.5 m MIN.
1.0 m
SECTION
SCALE 1:100
AECOM
The City of Lethbridge
Xeriscape Planting Report
Pathway
Figure - 14

Figure 15


ISS/REV: A
AECOM FILE NAME: 0112-322-00_00-L-F011_RX.dwg Saved By: wileyp PLOT: 22/12/2009 3:35:50 PM A SIZE 8.5" x 11" (215.9mm x 279.4mm)
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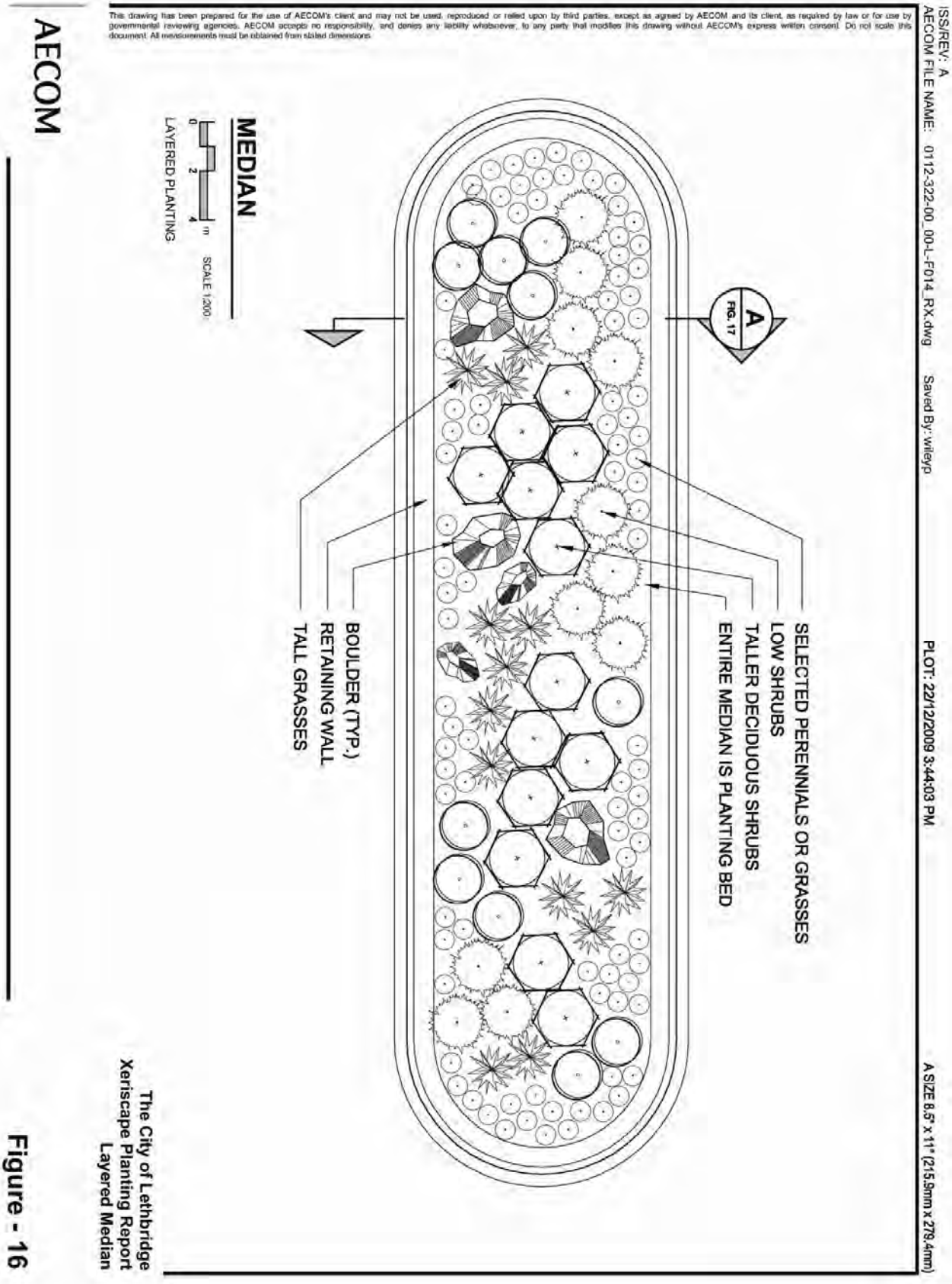
NATURAL AREA
MOWED VERGE
PATHWAY
A
PATHWAY
0 2 4 m SCALE 1:200
THROUGH NATURAL AREA
2.0 m MINIMUM FOR ASPHALT PATHS.
MOWED VERGE WIDTH TO SUIT HABITAT, CPTED PRINCIPLES AND AESTHETIC OBJECTIVES.
FOR MAIN REGIONAL PATHS (HIGH PRIORITY CPTED ZONES) MINIMUM VERGE WIDTH IS 6.0 m.
FOR LOCAL ASPHALT PATHS VERGE WIDTH MAY BE A MINIMUM OF 1 m WIDE.
FOR GRAVEL OR MULCH PATH IN A NATURAL AREA NO MOWED VERGE MAY BE REQUIRED.
SECTION
A
0 1 2 m SCALE 1:100
PATHWAY
NATURAL VEGETATION IS NOT MAINTAINED
MOWED VERGE TO MAINTAIN SIGHTLINES FOR NATURAL SURVEILLANCE (CPTED)
PATHWAY
AECOM
The City of Lethbridge
Xeriscape Planting Report
Natural Area Pathway
Figure - 15

Figure 16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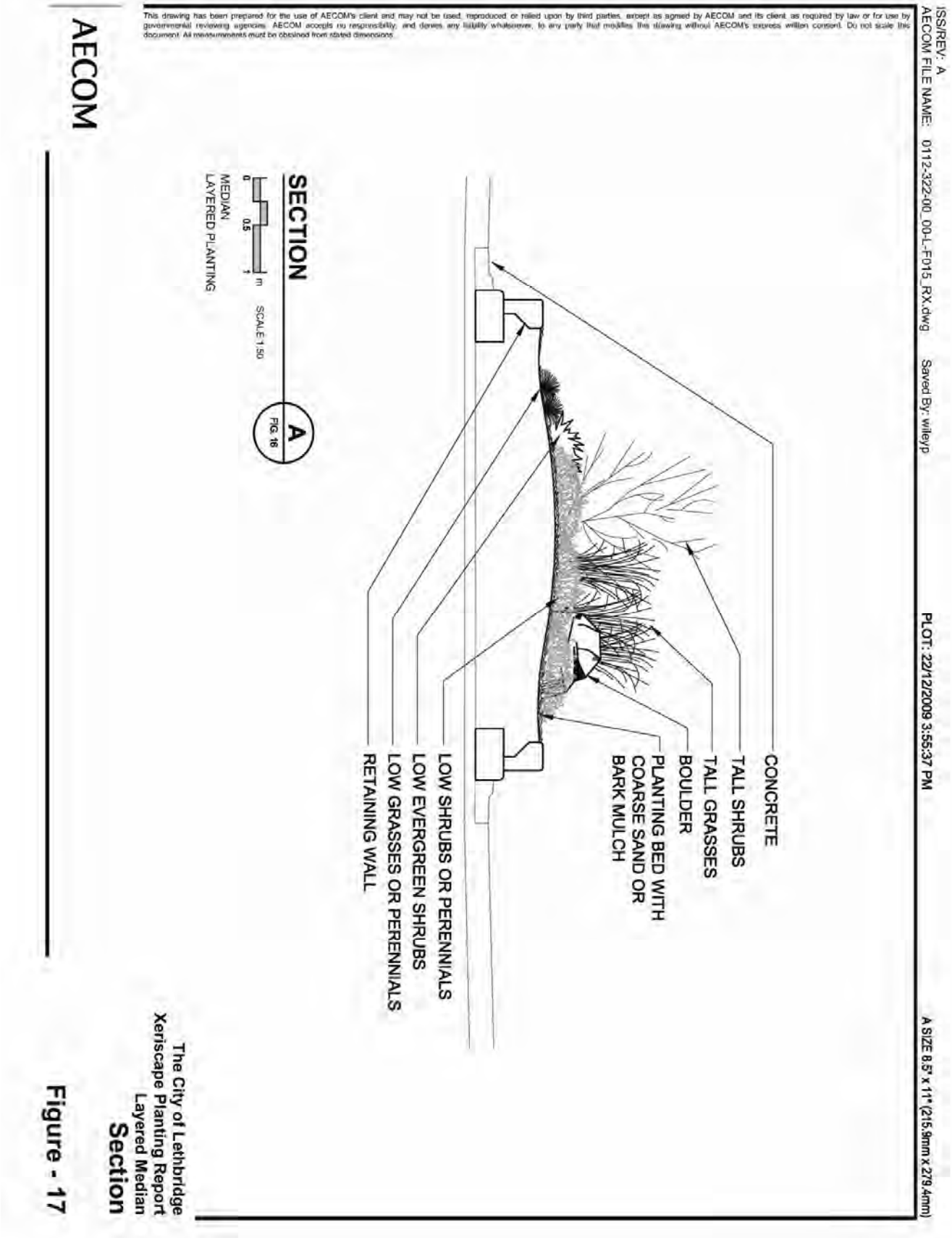
ISS/REV: A
AECOM FILE NAME: 0112-322-00_00-L-F014_RX.dwg
Saved By: wileyp
PLOT: 22/12/2009 3:44:03 PM
A SIZE 8.5" x 11" (215.9mm x 279.4mm)
A
FIG. 17
SELECTED PERENNIALS OR GRASSES
LOW SHRUBS
TALLER DECIDUOUS SHRUBS
ENTIRE MEDIAN IS PLANTING BED
BOULDER (TYP.)
RETAINING WALL
TALL GRASSES
MEDIAN
LAYERED PLANTING
0 2 4 m
SCALE 1:200
The City of Lethbridge
Xeriscape Planting Report
Layered Median
AECOM
Figure - 16

Figure 17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AECOM FILE NAME: 0112-322-00_00-L-F015_RX.dwg Saved By: wileyp PLOT: 22/12/2009 3:55:37 PM A SIZE 8.5" x 11" (215.9mm x 279.4mm)
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CONCRETE
TALL SHRUBS
TALL GRASSES
BOULDER
PLANTING BED WITH COARSE SAND OR BARK MULCH
LOW SHRUBS OR PERENNIALS
LOW EVERGREEN SHRUBS
LOW GRASSES OR PERENNIALS
RETAINING WALL
SECTION
A
FIG. 16
SCALE 1:50
0 0.5 1 m
MEDIAN LAYERED PLANTING
AECOM
The City of Lethbridge
Xeriscape Planting Report
Layered Median
Section
Figure - 17

ISS/REV: A
AECOM FILE NAME: 0112-322-00_00-L-F016_RX.dwg Saved By: wileyp
PLOT: 22/12/2009 4:04:01 PM
A SIZE 8.5" x 11" (215.9mm x 279.4mm)
WATER HARVESTING ON FLAT SITES
- GRADE FLAT SITES IN ORDER TO CONCENTRATE RUNOFF AND IRRIGATION MOISTURE IN DISHED AREAS FOR MORE WATER DEPENDENT PLANTS AND RESERVE SLOPING AREAS FOR MORE DROUGHT TOLERANT PLANTS.
- USE PERMEABLE SOILS FOR PLANTING BEDS.
- THE USE ROCK MULCH INCREASES MOISTURE RETENTION AND REDUCES EVAPORATION.
PLANTING BED
PLANTING BED
PLANTING BED
PLANTING BED
WATER HARVESTING ON SLOPING SITES
- GRADE SLOPING SITES IN A WAY THAT CREATES DEPRESSIONS IN ORDER TO TRAP WATER RATHER HAVE IT RUN OFF.
WATER HARVESTING
0 1 2 m SCALE 1:100
FLAT SITE SECTION
WATER HARVESTING
0 1 2 m SCALE 1:100
SLOPING SITE SECTION
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AECOM
The City of Lethbridge
Xeriscape Planting Report
Water Harvesting Scheme
Sections
Figure - 18

Figure 18

XERISCAPE PLANT LIST

			H - High M - Medium L - Low	H - High M - Medium L - Low	High Vis bility	Conventional	Natural		
Scientific Name	***Variety***	***Common Name***	***Saline Tolerance***	***Moisture Need***	***CPTED***	***Landscape***	***Landscape***	***Spread***	***Zone***
Deciduous Trees									
Acer ginnala	Single Stem	Amur Maple	M/H	M/L	*	C		3	2
Crataegus succulenta		Fleshy Hawthorn	M/H	M/L	*	C	N	8	3
Elaeagnus angustifolia	Russian	Olive	H	L		C		5	3
Fraxinus pennsylvanica	Bergeson	Green Ash	M/H	M/L	*	C		8	3
Fraxinus pennsylvanica 'Heuver'	Foothills	Green Ash	M/H	M/L	*	C		8	3
Fraxinus pennsylvanica	Prairie Spire	Green Ash	M/H	M/L	*	C		6	2-3
Fraxinus pennsylvanica		Green Ash	M/H	M/L	*	C		8	3
Fraxinus pennsylvanica	Northern Gem	Green Ash	M/H	M/L	*	C		7	3
Fraxinus pennsylvanica	Patmore	Green Ash	M/H	M/L	*	C		8	2-3
Populus tremula erecta	Swedish Columnar	Aspen	M/H	M/L	*	C		1.5	2
Populus tremuloides	Advance	Aspen	M/H	M	*	C		3	2
Populus tremuloides	Pikes Bay	Aspen	M/H	M	*	C		3	2
Populus tremuloides		Trembling Aspen	M/H	M/L	*	C	N	3	1
Sorbus americana	American	Mountain Ash	L	M/L	*	C		5	2
Sorbus aucuparia 'Blackhawk'	Blackhawk	European Mountain Ash	L	M/L	*	C		2.5	3
Sorbus aucuparia 'Rossica'	Russian	Mountain Ash	L	M/L	*	C		4	3
Sorbus decora	Showy	Mountain Ash	L	M/L	*	C		5	2
Ulmus americana		American Elm	H	M/L	*	C		10	2
Ulmus americana 'Brandon'		Brandon Elm	H	M/H	*	C		10	2-3
Evergreen Trees									
Picea glauca densata	Black Hills	White Spruce	M/H	M		C		4	2
Picea pungens		Colorado Spruce	M/H	M/L		C		5	2
Picea pungens	Bakeri	Spruce	M/H	M/L		C		3	2
Picea pungens	Fat Albert	Spruce	M/H	M/L		C		6	2
Picea pungens	Hoopsii	Spruce	M/H	M/L		C		2	2

Scientific Name	*Variety*	*Common Name*	*Saline Tolerance*	*Moisture Need*	*CPTED*	*Landscape*	*Landscape*	*Spread*	*Zone*
Picea pungens	Montgomery	Spruce	M/H	M/L		C		1	2
Picea pungeuns Fastigiata	Columnar Blue	Spruce	M/H	M/L	*	C		3	2
Picea pungens glauca	Colorado Blue	Spruce	M/H	M/L		C		5	2
Pinus aristata		Bristlecone Pine	M	M/L		C		2	2
Pinus cembra		Swiss Stone Pine	M	M/L		C		5	3-4
Pinus ponderosa		Ponderosa Pine	M/H	M/L	*	C		6	2
Pinus sylvestris		Scotch Pine	M/L	M/L	*	C		6	2-3
Pinus sylvestris fastigiata		Columnar Scotch Pine	M/L	M/L	*	C		1	2-3
Pinus flexilis		Limber Pine	M	M/L		C		2	4
Evergreen Shrubs									
Juniperus communis 'Effusa'	Effusa	Common Juniper	M	M/L	*	C	N	2	2
Juniperus chinensis	Mint Julep	Juniper	M	M/H	*	C		2	4
Juniperus horizontalis	Andorra	Juniper	H	M/L	*	C		2	2
Juniperus horizontalis	Blue Chip	Horizontal Juniper	H	M/L	*	C		2	3-4
Juniperus horizontalis	Creeping/Horizontal	Juniper	M/H	M/L	*	C	N	2	2
Juniperus horizontalis	Gold Coast	Horizontal Juniper	M/H	M/L	*	C		1.5	2
Juniperus horizontalis	Prince of Wales	Horizontal Juniper	M/H	M/L	*	C		2	2
Juniperus horizontalis	Wilton Carpet	Juniper	M/H	M/L	*	C		1	3
Juniperus sabina		Savin Juniper	M/H	M/L	*	C		2	2
Juniperus sabina	Arcadia	Juniper	M/H	M/L	*	C		2	3
Juniperus sabina	Buffalo	Horizontal Juniper	M/H	M/L	*	C		2	2
Juniperus sabina	Calgary Carpet	Horizontal Juniper	M/H	M/L	*	C		1.5	2
Juniperus sabina	New Blue Tam	Juniper	M/H	M/L	*	C		1.5	3
Juniperus scopulorum	Rocky Mountain	Juniper	M/H	L		C		1.5	2
Juniperus scopulorum	Cologreen	Juniper	M/H	M/L		C		1.5	2
Juniperus scopulorum	Grey Gleam	Juniper	M/H	L		C		1.5	2
Juniperus scopulorum	Moonglow	Juniper	M/H	M/L		C		1.5	2
Juniperus scopulorum	Witchita Blue	Juniper	M/H	L		C		1.5	2
Picea glauca conica	Dwarf Alberta	Spruce	M/H	L		C		1	3
Pinus cembra		Swiss Mountain Pine	M	M/L		C		5	4
Pinus mugo		Mugo Pine	M/H	M/L		C		2	2
Pinus mugo pumila		Dwarf Mugo Pine	M/H	M/L	*	C		1.5	3
Deciduous Shrubs									

Scientific Name	Variety	Common Name	Saline Tolerance	Moisture Need	CPTED	Landscape	Landscape	Spread	Zone
Acer ginnala	Multi-stemmed	Amur maple	M/H	M/L		C		3	2
Atriplex canescens		Fourwing Saltbush	H	L	*	C		1.5	3
Berberis thunbergii	Emerald Carousel	Barberry	M/H	L	*	C		1.25	3
Berberis thunbergii	Crimson Pygmy	Barberry	M/H	L	*	C		0.6	3
Buxus sp.		Boxwood	M	L	*	C		0.5	3-4
Caragana arborescens	Walker Weeping	Caragana	H	M/L	*	C		0.5	2
Caragana arborescens	Sutherland	Caragana	H	M/L	*	C		1	2
Caragana frutex 'Globosa'		Globe Caragana	H	M/L	*	C		1	2
Cotoneaster lucidus/acutifolia		Peking Cotoneaster	M/H	M/L		C		1.5	2
Cotoneaster integerrimus		European Cotoneaster	M/H	M/L		C		4	2
Potentilla fruticosa	Abbotswood	Potentilla	H	M/L	*	C		1	2
Potentilla fruticosa	Cobalt	Potentilla	H	M/L	*	C		1	2
Potentilla fruticosa	Coronation Triumph	Potentilla	H	M/L	*	C		1	2
Potentilla fruticosa	Floppy Disk	Potentilla	H	M/L	*	C		0.75	2
Potentilla fruticosa	Gold Drop	Potentilla	H	M/L	*	C		0.75	2
Potentilla fruticosa	Goldfinger	Potentilla	H	M/L	*	C		1	2
Potentilla fruticosa	Gold Star	Potentilla	H	M/L	*	C		0.75	2
Potentilla fruticosa	Jackman	Potentilla	H	M/L	*	C		1	2
Potentilla fruticosa	Katherine Dykes	Potentilla	H	M/L	*	C		1	2
Potentilla fruticosa	Mango Tango	Potentilla	H	M/L	*	C		0.6	2
Potentilla fruticosa	Moonlight	Potentilla	H	M/L	*	C		1.2	2
Potentilla fruticosa	Orange Whisper	Potentilla	H	M/L	*	C		1	2
Potentilla fruticosa	Pink Beauty	Potentilla	H	M/L	*	C		1	2
Potentilla fruticosa	Red Ace	Potentilla	H	M/L	*	C		1	2
Potentilla fruticosa	Red Robin	Potentilla	H	M/L	*	C		0.6	2
Potentilla fruticosa	Snowbird	Potentilla	H	M/L	*	C		1	2
Potentilla fruticosa	Yellow Gem	Potentilla	H	M/L	*	C		0.75	2
Prinsepia sinensis		Cherry Prinsepia	M/H	M/L		C		2	3
Rhus glabra		Smooth Sumac	M/H	M/L		C		3	2
Rhus trilobata		Threeleaf Sumac /Skunkbush	M/H	M/L	*	C	N	1	2
Ribes alpinum	Schmidt	Alpine Currant	M/H	L		C	N	1.5	2-3
Ribes aureum		Golden Currant	M	L		C	N	1.5	2
Ribes nigrum	Wild Black	Wild Black Currant	M	M		C	N	1	2
Ribes nigrum	Wellington	Currant	M	M/H	*	C		1	2
Ribes nigrum	Ben Nevis	Currant	M	M/H	*	C		1	3
Ribes oxycanthoides	Native	Gooseberry	M	M/L	*	C		1	2

Scientific Name	Variety	Common Name	Saline Tolerance	Moisture Need	CPTED	Landscape	Landscape	Spread	Zone
Ribes 'Pixwell'	Pixwell	Gooseberry	M	M	*	C		1.5	2
Ribes sativum	White	Currant	M	L		C		1	2-3
Rosa acicularis		Wild Prickly Rose	M/H	L		C		1	2
Rosa rubrifolia		Redleaf Rose	M/H	M		C		1.5	3
Rosa x rugosa	Alexander McKenzie	Rose	M/H	M		C		1.5	2
Rosa x rugosa	Champlain	Rose	M/H	L	*	C		1	3
Rosa x rugosa	David Thompson	Rose	M/H	M		C		1	2
Rosa x rugosa	F.J. Grootendorst	Rose	M/H	M		C		1.25	3
Rosa x rugosa	Henry Hudson	Rose	M/H	M	*	C		0.6	2
Rosa x rugosa	Henry Kelsey	Explorer Rose	M/H	L		C		1.5	2
Rosa x rugosa	Jens Munk	Rose	M/H	M		C		1.2	2
Rosa x rugosa	John Cabot	Rose	M/H	M		C		1.75	2
Rosa x rugosa	John Davis	Explorer Rose	M/H	L		C		1.5	2
Rosa x rugosa	John Franklin	Rose	M/H	M		C		1	2
Rosa x rugosa	Martin Frobisher	Rose	M/H	M		C		1.2	2
Rosa x rugosa	Pink Grootendorst	Rose	M/H	M		C		1.25	2
Rosa x rugosa	William Baffin	Explorer Rose	M/H	L		C		1.5	2
Rosa woodsii		Woods Rose	M/H	L	*	C		1	2
Rubus	Fallgold	Raspberry Fall gold	M/L	M		C		1.5	3
Rubus	Red River	Raspberry Red River	M/L	M		C		1.5	3
Salix bebbiana		Beaked Willow	M	M/L		C	N	2	2
Salix brachycarpa	Blue Fox	Willow Blue Fox	M	M/L	*	C		1	2-3
Sorbus decora		Showy Mountain Ash	L	M/L		C		4	3
Spiraea x arguta	Garland Spirea	Spirea	M/H	M/L	*	C		1	2-3
Symphoricarpos occidentalis		Buckbrush	M	L	*	C	N	1	1
Perennial Grasses									
Calamagrostis x acutifolia	Karl Foster	Reed Grass	M/H	L	*	C		1	3
Elymus arenarius		Blue lyme grass	M	L	*	C		1	3
Festuca ovina		Blue fescue	M	L	*	C	N	0.3	2
Herbaceous Perennials									
Achillea millefolium		Common yarrow	M/H	L	*	C	N	0.6	1
Achillea ptarmica		Sneezewort	M/H	L	*	C		0.45	1
Achillea tomentosa		Dwarf woolly yarrow	M/H	L	*	C		0.3	3

Scientific Name	*Variety*	*Common Name*	*Saline Tolerance*	*Moisture Need*	*CPTED*	*Landscape*	*Landscape*	*Spread*	*Zone*
Anemone sylvestris		Windflower	M	M	*	C		0.45	2
Antennaria rosea		Pussytoes	M	L	*	C	N	0.15	3
Anthemis Tinctoria		Golden Marguerite	M	L	*	C	N	0.25	2
Artemisia Ludoviciana		Sage	H	L	*	C	N	0.6	2
Artemisia schmidtiana		Silver Mound	H	L	*	C		0.45	1
Artemisia stellerana		Silver Brocade	H	L	*	C		0.6	2
Campanula carpatica		Carpathian bellflower	M	L	*	C		0.3	2
Cerastium tomentosum		Snow-in-summer	M	L	*	C		0.6	2
Coryphantha vivipara		Pincushion cactus	M	L	*	C		0.1	2
Echinacea pupurea		Prairie purple coneflower	M	L	*	C	N	0.6	3
Echinops ritro		Globe thistle	H	L	*	C	N	0.6	2
Geranium macrorrhizum		Bigfoot geranium	M	L	*	C		0.45	2
Gypsophila repens		Creeping babysbreath	H	L	*	C		0.45	2
Hemerocallis		Daylily	M	L	*	C		1	2
Limonium latifolium		Sea lavender	H	M/L	*	C		0.6	2
Linum perenne		Perennial flax	M	L	*	C		0.3	2
Opuntia polyacantha		Plains prickly pear cactus	M	L	*		N	0.3	2
Saponaria ocymoides		Rock soapwort	M	L	*	C		0.45	2
Sedum ssp.		Stonecrop	H	L	*	C		0.6	2
Sempervivum		Hens and chicks	H	L	*	C		0.4	2
Sphaeralcea coccinea		Prairie mallow	H	L	*	C		0.4	3
Stachys byzantina		Lambs ears	H	L	*	C		0.45	2
Stachys grandiflora		Big betony	H	L	*	C		0.45	2
Thymus		Thyme	M/H	L	*	C		0.6	4
Yucca glauca		Yucca	H	L	*	C		1	3

Appendix G: Phase I Budget Cost Estimate, May 2010

May 9, 2010

50% allowance for connection

Lethbridge Cemetery: Preliminary Concept Plan
Phase I Budget Cost Estimate May 2010

NOTE: Unless noted, all prices are for supply and installation and reflect typical unit costs in the Lethbridge area

Category	Item	Size	Unit	Unit Cost*	Quantity	Amount
1 SITEWORK						
1.1 **Demolition and Removal**						
	Misc clearing and disposal		allow	$ 5,000.00	1	$ 5,000.00
1 2 **Site Prep. and Grading**						
	Site grading		m^3	$ 4 00	21,000	$ 84,000.00
	Stockpiling of topsoil		m^2	$ 2 00	42,000	$ 84,000.00
	Pond excavation		m^3	$ 4 00	40,000	$ 160,000.00
	Pond liner		m^2	$ 2 00	15,000	$ 30,000.00
	Pond aeration system		ls	$ 20,000.00	1	$ 20,000.00
1 3 **Deep utilities**						
	Storm sewer piping		lm	$ 250 00	100	$ 25,000.00
	Manholes		ea	$ 3,000.00	2	$ 6,000.00
	Water service		ls	$ 10,000.00	1	$ 10,000.00
	Water piping on site		lm	$ 100 00	500	$ 50 000.00
	Septic tank and absorption field		ls	$ 15 000.00	1	$ 15 000.00
	Connection to city water and associated metering		each	$ 5 000.00	1	$ 5 000.00
	Water from the SMRID system ($3 - 400k)		allowance	$ 200 000.00	1	$ 200 000.00
1.4 **Shallow utilities**						
	Gas connection fees		ls	$ 4,000.00	1	$ 4,000.00
	Electrical connection fees		ls	$ 8,000.00	1	$ 8,000.00
	Communications connection fees		ls	$ 2,000.00	1	$ 2,000.00
2 HARD LANDSCAPE						
2.1 **Entry walls**						
	Entry wall & gateway features		each	$ 75,000.00	1	$ 75,000.00
2 2 **Road construction**						
	Trench and install conduit for irrigation sleeves		lm	$ 50 00	100	$ 5,000.00
	Subgrade preparation		m^2	$ 2 00	6,000	$ 12,000.00
	Granular base		m^2	$ 10 00	6,000	$ 60,000.00
	Asphalt pavement		m^2	$ 19 00	6,000	$ 114,000.00
	Concrete gutter: 500mm w/50mm depth (both sides)		lm	$ 100 00	692	$ 69,200.00
2 3 **Fencing**						
	Chainlink fencing (Operations Yard)		lm	$ 90 00	140	$ 12,600.00
3 BUILDINGS						
3.1 **Adminstration**						
	Modular office building		m^2	$ 3,500.00	100	$ 350,000.00
	Foundations and misc		Allow	$ 15,000.00	1	$ 15,000.00
3 2 **Operations**						
	Lockable, prefab steel equipment storage building	12 m x 18 m	Allow	$ 25,000.00	1	$ 25,000.00
	Granular surfaced yard	1200 m2	Allow	$ 20 000.00	1	$ 20 000.00
4 SITE FURNISHINGS & FIXTURES						
4.1 **Signage**						
	Site signage		each	$ 5,000.00	2	$ 10,000.00
4 2 **Site furnishings**						
	Benches bike racks trash bollards etc w conc pad		each	$ 2 500.00	10	$ 25 000.00
4 3 **Flower watering station**						
	"Necessarium" structures		each	$ 5,000.00	3	$ 15,000.00
4.4 **Lighting**						
	Sign and site lighting	estimate	Allow	$ 30,000.00	1	$ 30,000.00
5 SOFT LANDSCAPE						
5.1 **General**						
	Place & fine grade stockpiled soil		m^2	$ 5 00	36,000	$ 180,000.00
	Soil amendment (compost)		m^2	$ 3 00	36,000	$ 108,000.00
	Soil amendment (Lassenite @.075 lb/m2)		m^2	$ 0 02	36,000	$ 720 00
	Topsoil (planting bed growing medium - 500 mm depth)		m^2	$ 22 50	0	$ -
	Allow for irrig'n landsc. areas		m^2	$ 15 00	34,800	$ 522,000.00
5 2 **Planting**						
	Coniferous trees	2.5 m ht.	each	$ 400 00	100	$ 40,000.00
	Deciduous trees	75 mm cal.	each	$ 400 00	175	$ 70,000.00
	Seed and hydromulch		m^2	$ 3 00	34,800	$ 104,400.00
	Wetland planting (retention ponds)		allow	$ 5,000.00	1	$ 5,000.00
				Subtotal (sec 1-5 only)		**$ 2,575,920.00**
6 CONSTRUCTION EXPENSES						
	Survey layout		allow	$ 2,500.00	1	$ 2,500.00
	Insurance		allow	$ 1,500.00	1	$ 1,500.00
	Electrical service		allow	$ 5,000.00	0	$ -
	Site Trailer		allow	$ 4,000.00	1	$ 4,000.00
	Portable toilets	3 months constr	monthly	$ 450 00	3	$ 1,350.00
	Permits and Licences		allow	$ 2,500.00	1	$ 2,500.00
	Project Signage		allow	$ 1,000.00	2	$ 2,000.00
	Mobilization/demobilization		allow	$ 7,500.00	1	$ 7,500.00
	Testing (slump test, Proctor density etc)		allow	$ 2,000.00	1	$ 2,000.00
	Bonding		allow	$ 2,500.00	1	$ 2,500.00
	Legal		allow	$ 2,500.00	1	$ 2,500.00
	Shop drawings		allow	$ 1 000.00	1	$ 1 000.00
				Subtotal (sec 6 only)		**$ 29,350.00**
	(Project management included in design fees)					
				Total cost		**$ 2,605,270.00**
				Contingency (15%)		$ 390,790.50
				Total Budget Estimate		$ 2,996,060.50

Appendix H: Programming Brief

E. LEES & ASSOCIATES CONSULTING LTD.

City of Lethbridge
Lethbridge Cemetery - PROGRAMMING BRIEF

September 2, 2010

This Programming Brief for the Lethbridge Cemetery System provides an itemized list of everything that is expected to (i.e. should and could) occur at a cemetery site. It provides the basis for those elements and spaces and activities that **should be accommodated and provided for in the physical design**.

1. **PROVIDE FOR INTERMENTS**
   Interment options include:

- **Traditional In-ground Casket Lots**
  - single depth lots, arranged in sections
  - processional routes to each section
  - Pallbearer distance < 60 m.
  - space for graveside gathering and visitation

- **Culturally-specific In-ground Burial Lots**
  - single depth lots, aligned and configured according to needs
  - processional routes to each section
  - Pallbearer distance < 60 m.
  - space for graveside gathering and visitation
  - specific ceremonial elements (e.g. Ting vessels; places for offerings etc)

- **Double-depth In-ground Casket Lots**
  - lots available for two casket interments/lot; at 6'and 9' depth
  - vaults can be installed upon request where space permits, or in sections with preinstalled vaults (stacked singles or doubles)
  - processional routes to each section
  - Pallbearer distance < 60 m.
  - space for graveside gathering and visitation

- **In-ground Cremation Lots**
  - in-ground cremation lots arranged in sections
  - space for graveside gathering and visitation

- **Ossuary Interment**
  - below-ground vessel with secured access portal
  - space for gathering and visitation

- **Garden Vessel Interment**
  - Above-ground vessel with secured access portal
  - space for gathering and visitation

- **Columbarium Niche Inurnment**
  - Columbaria niches within walls/free-standing structures of various sizes; styles

- space for gathering and visitation
- possible indoor as well as outdoor locations
- indoor sites can be associated with mausoleum building

- **Scattering Garden**
  - Planted garden beds for the scattering of cremated remains
  - space for gathering and visitation

- **Green Burial Lots**
  - single depth lots, arranged in sections
  - processional routes to each section
  - Pallbearer distance < 60 m.
  - space for graveside gathering and visitation
  - natural or scenic visual context
  - some physical separation from traditional casket interment area

- **Possible Mausoleum/Crypt Interment**
  - For individuals (in ground crypts) or families (mausoleum crypts in free-standing structures, or attached to cemetery building)
  - processional routes to crypt or mausoleum
  - Pallbearer distance < 60 m.
  - space for graveside gathering and visitation
  - larger structure would require feasibility study
  - architecture character and features would require study and careful placement within cemetery

Interment space should be organized according to site characteristics and qualities, infrastructure and access and projections of demand for different interment options offered. Interment areas should be named / numbered such that they facilitate cemetery records management and wayfinding by visitors. There should be no repeating lettering or numbering, and sections or "neighbourhoods" should have unique, meaningful names or designations.

2. FACILITATE MAINTENANCE & OPERATIONS

- Equipment access, storage and service areas
- Signage
- Equipment routes
- Snow clearing, maneuvering space
- Tree maintenance space
- Opening and Closing space
- Turf maintenance equipment maneuvering space

3. ENCOURAGE AND PROVIDE FOR VISITATION/PUBLIC ENGAGEMENT

- Vehicle routes
- Parking areas
- Pedestrian routes
- Cemetery office
- Benches/seating
- Scenic view points
- Visual screening and noise buffering

- Aesthetic features – horticultural, structural elements, water features
- Cultural features – public art, interpretive and historical signage
- Walls for memorial plaques
- Public memorials/monuments
- Gifting program (benches, trees, public art)
- Shade and shelter (built and planted)
- Outdoor gathering areas
- Washrooms and drinking water
- Flower stations with water taps and trash receptacles
- Signage (directional, informational, interdictory)
- Maps and visitor information kiosks (facility information)

4. ACCOMMODATE PRIVATE DONATIONS AND GIFTS

- Products (e.g. trees, benches) made available for purchase with design criteria and available sites designated in advance
- -Gifting program for custom items (e.g. sculpture; garden areas) with design criteria and available sites designated in advance

5. ENSURE PUBLIC SAFETY

- Emergency entry and exit routes
- Fencing and gates
- Signage
- Lighting
- Stormwater drainage
- Coulee setbacks

6. ACCOMMODATE RECREATION

- Pathways and trails
- Bike racks
- Bird watching, wildlife viewing opportunities
- Seating and shelter

7. PROVIDE FOR PRIVATE AND PUBLIC CEREMONIES AND EVENTS

- Traditional, indoor and outdoor funeral, memorial and community use spaces in a range of sizes, with a range of physical qualities
- Culturally-specific ceremonial spaces and features (for *Ching Ming, Obon* etc)
- Cemetery-wide ceremonial spaces and features (for “Night for all Souls”, “Day of the Dead” etc)
- Military and paramilitary ceremonial spaces (for assembly, march-past, flag raising etc)

8. RECOGNIZE, MANAGE AND CELEBRATE THE SURROUNDING NATURAL ENVIRONMENT

- Habitat areas – natural landscape, plants, water
- Coulee (ecotone) habitat enhancements
- Interpretive signage/other information related to the area’s natural history and environment

Appendix I: Spatial Needs Analysis: Photo inventory of proposed infill sites

Mountain View

AREA A

AREA B

AREA C

AREA D

AREA E

AREA F

AREA G

AREA H

AREA I

AREA J

AREA K

AREA L

AREA M

Archmount

AREA A

AREA B

AREA C

AREA D

AREA D

AREA E

AREA F

AREA G

AREA H