FINAL REPORT:
A structured approach for involving local stakeholders in design and management decisions for the Wasatch Hollow Open Space area

By

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EXECUTIVE SUMMARY

Stakeholder involvement in planning and management efforts exists across a spectrum from cursory opportunities for input, to more intensive participatory efforts that seek to include stakeholder views and concerns in the identification and evaluation of potential alternatives. Often, the institutions or organizations responsible for a participatory effort have the best of intentions, but lack the ability to incorporate science and value-based concerns into the decision process in a meaningful way. Tools from the decision sciences are available to help structure decision processes so as to ensure appropriate framing of the problem or issue at hand, careful identification of diverse values, concerns and alternatives, and deliberate weighing of the pros and cons of different actions and options.

The work reported here is the result of a participatory planning process initiated by Salt Lake City to inform the design and management of the 10-acre Wasatch Hollow Open Space. The Wasatch Hollow Open Space parcel was acquired in segments over a period of several years and will be protected through conservation easements that prevent development and promote conservation values. Given diverse and strong interests of various stakeholders in this planning process, it was decided that a deliberative, structured decision process was necessary to accurately identify stakeholder values and objectives, and to help ensure that both the near-term design and the long-term management of the Wasatch Hollow Open Space area reflects these objectives.

To achieve this aim, we (consultants Arvai and Wilson) worked with the Salt Lake City Open Space Lands Program to identify a list of stakeholder groups that would be involved in an initial round of meetings held in January 2010. These groups included City representatives, community members living around the Open Space, neighboring churches and schools, Open Space board members, and content area experts (e.g., ecologists). Over the course of one week, we led facilitated discussions of stakeholder concerns and objectives, as well as alternative means by which these concerns and objectives could be addressed. Participants in the workshops were also asked to provide performance measures, or ways in which the identified objectives could be operationalized and used to evaluate future design and management plans. We then summarized the workshop discussions, identifying fundamental objectives that were shared by the majority of participants, and potential design and management alternatives that should be considered.

Participants in the workshops were nearly unanimous in their identification of 5 fundamental objectives for the design and management of the Wasatch Hollow Open Space. It is our suggestion that these five objectives form the basis of future efforts to develop and evaluate alternative open space plans:

1. The ecology of Emigration Creek, the riparian corridor, and the adjacent Open Space area be restored and protected;
2. The boundaries that exist between the Wasatch Hollow Open Space and adjacent private properties be clearly defined and respected by all parties;
3. The extent and type of public access that is permitted in the Wasatch Hollow Open Space be informed primarily by environmental and restoration considerations;
4. Public safety be enhanced as it relates to both the Wasatch Hollow Open Space and the adjacent private properties; and
5. Coordination and collaboration between different stakeholder groups be enhanced and fostered during both the planning and implementation (design and management) of the Wasatch Hollow Open Space area.

Two additional fundamental objectives were discussed at length in many of the workshops. It is our suggestion that these two objectives receive attention from content area experts and decision makers during deliberation about the development and evaluation of alternative open space plans:

1. The use of an adaptive management framework to guide the long-term monitoring and management of the Wasatch Hollow Open Space area; and
2. The need to keep the budget for both the design and long-term management within a reasonable margin.

Regarding potential alternatives, or aspects of alternative design and management plans, participants clearly identified several components that the Salt Lake City Open Space Program should, at the very least, consider. These include:

1. The inclusion of alternative open space "clusters", or different design and management plans implemented in different areas of the 10-acre Open Space site;
2. Restricted dog access;
3. The creation of buffer zones to widen and protect boundaries between private and public property;
4. The restoration or removal of the abandoned house currently on City property;
5. A focus on limited passive use (e.g., walking, wildlife viewing) that does not conflict with ecological restoration goals;
6. The inclusion of alternative footpath designs that facilitate passive use where appropriate but minimize ecological impact;
7. Removal of the rope swing to minimize environmental and liability risk;
8. Removal, relocation, or redesign of existing utilities, drainage and flood control;
9. The creation of educational and research partnerships to facilitate long-term monitoring of ecological and social objectives; and,
10. The exploration of cost-effective forms of enforcement ranging from police patrols to community-based initiatives.

Moving forward, participants in the ongoing decision making process should prioritize these seven fundamental objectives prior to evaluating any potential alternatives that are developed. The alternatives should then be presented in a format that depicts the expected level of performance across these objectives, allowing participants to evaluate the alternative in light of their own priorities. Support for an alternative or set of alternatives should be determined through a combination of swing weighting and approval voting. Swing weighting encourages respondents to think about the tradeoffs they are willing to make across objectives, while approval voting identifies all acceptable alternatives as opposed to forcing a choice for one "best" option. At the very least, it is important that alternatives be characterized in terms of the objectives that they best represent so that participants can quickly align their preferences with the option(s) that best suits them. Although 100% support for one option cannot be guaranteed, such an approach is likely to result in the identification of an alternative or set of alternatives that will be supported by the strong majority and can be sent forward to the City Council for final approval.

1. Introduction

Examples of stakeholder involvement in planning and management efforts exist across multiple contexts; ranging from the siting of industrial complexes and proposed municipal developments to the development of plans for fisheries and forest management. In many of these examples, however, stakeholder participation has been treated as little more than a marginal addition—and sometimes an afterthought—to what are typically viewed as decisions best left to bureaucrats or technical experts.

Another, much smaller set of cases make use of structured stakeholder consultation efforts, which include opportunities for stakeholders to access information about a particular issue (e.g., in print, in-person, or on-line) and express their views and concerns (e.g., through public meetings, workshops, small groups) in a way that addresses their underlying concerns yet also makes sense to, and catches the attention of, decision makers. Examples include the Water Use Planning process in British Columbia (Arvai et al. 2001; Gregory et al. 2001b), a pilot project for the U.S. Department of Energy on the cleanup of contaminated sites (Arvai & Gregory 2003b), and several ongoing deliberative processes in Canada, the U.S., and the U.K. However, these efforts remain the exception, with failures to involve stakeholders in a meaningful way far outnumbering the successes.

In our view, a primary reason for the failure of most stakeholder processes stems from the absence of formal methods that effectively merge technical and non-technical concerns and then use this information in the creation of options that address the problem or problems at hand (Arvai 2007; Arvai & Gregory 2003a; Wilson & Arvai 2006). The result is the perception among many participants that (a) the process is driven by "alternatives" rather than being responsive to their values (this is true, for example, of many scenario-based planning efforts), (b) the opinions of technical experts dominate those of community members and other "non-technical" stakeholders, and (c) opportunities for input serve as little more than a diversion that draws attention away from where the "real" decisions are being made. Many of these problems stem from the absence of an approach that helps diverse participants to (i) understand—and help to frame—the problem that is the focus of the decision, (ii) express and clarify their issue-specific values and concerns, (iii) be involved meaningfully in the development of a recommended alternative (or alternatives), and (iv) carefully weigh the technical and non-technical pros and cons of different actions or options, including the uncertainty that is associated with predicted impacts.

To this end, the work that we conducted related to this project applies insights from the decision sciences and behavioral decision research to address these gaps. We focused our attention on the initial phases of the deliberative process, making use of tools from the decision sciences to clarify the relevant values of key stakeholders, and to identify aspects of alternative design and management plans that we believe should be considered by stakeholders and decision makers alike. These steps form the necessary basis for the development of a sound planning process and, later, a workable design and long-term management plan.

2. Study Location

In carrying out our work, we used a structured decision making (SDM) approach for involving diverse stakeholders in land management decisions for the Wasatch Hollow Open Space Area in Salt Lake City, Utah. The Wasatch Hollow Open Space area comprises three adjoining sites. All together, the three sites comprise approximately 10 acres of open space (Figure 1), which we treated as a single unit for planning purposes.

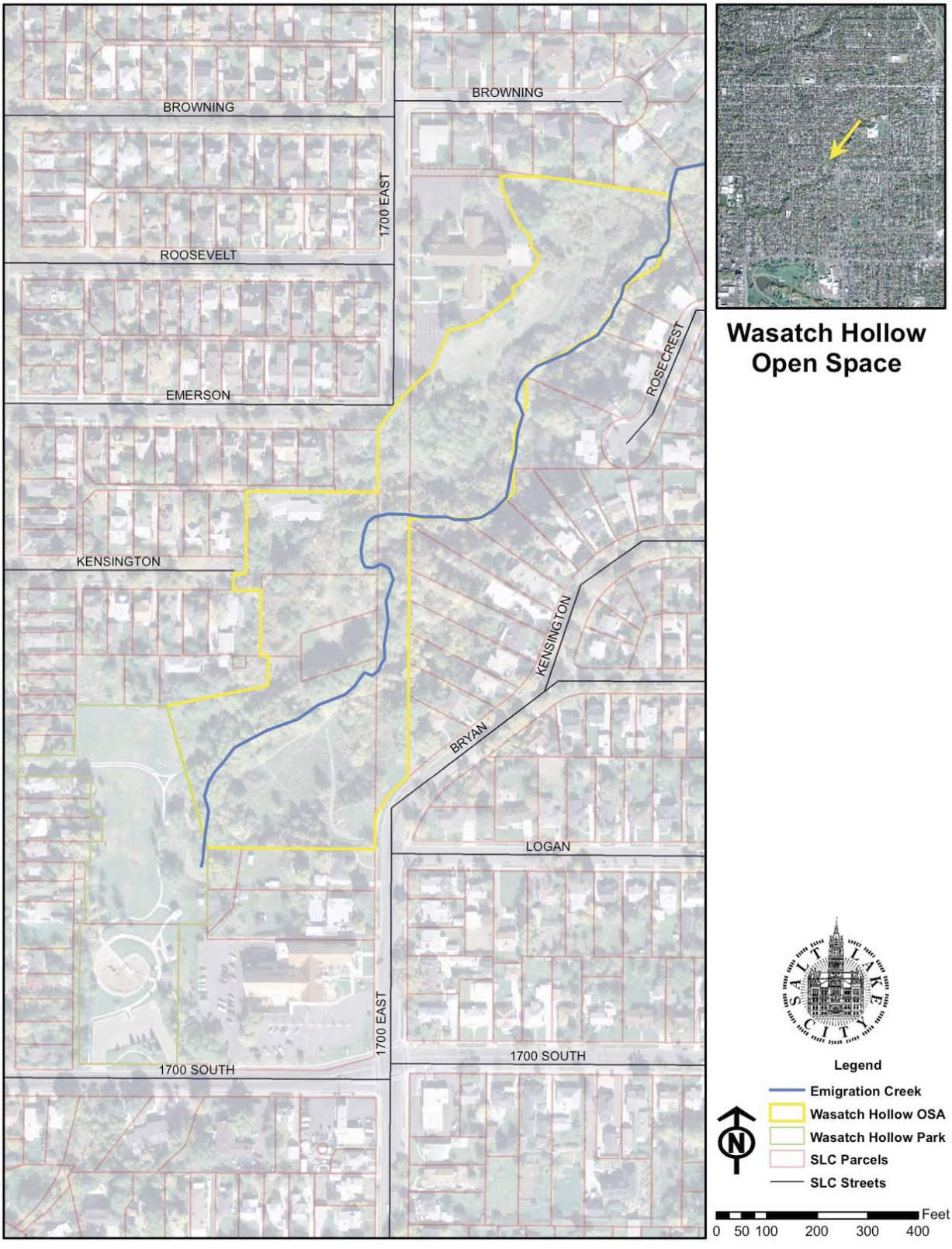

Figure 1. The Wasatch Hollow Open Space area (denoted by the yellow boundary line).

One of these sites, comprised of approximately 4-acres, is near the Wasatch Presbyterian Church on 1700 South and 1650 East and was previously designated by Salt Lake City as open space. The southern reaches of this parcel include a playground, a demonstration garden, pathways, lighting, and restrooms (known as Wasatch Hollow Park and not included in the current planning discussion). The northeastern reaches of this parcel are undeveloped and are part of the 10 acres under discussion.

The second site, which is commonly referred to as the "acquisition site", is located north of Wasatch Hollow Park. It comprises approximately 1.95 acres of land and is occupied by natural vegetation and historic springs that feed Emigration Creek year round. The plan to acquire this site was initially submitted by the Open Space Chair of Wasatch Hollow Community Council to the City through the Open Space Lands Program application process in June 2006. As the project developed, so did partnerships with community stakeholders and Utah Open Lands, a local non-profit land trust. During the public campaign to raise funds and secure this site as open space, the property was sold on different occasions to potential developers. Near the end of 2008, Salt Lake City both secured the required funds and found a willing seller. Included in this parcel is a residential dwelling that is currently uninhabited.

The third site, is located northeast of the acquisition site. It is slated to be donated to the City by the Church of Jesus Christ of Latter-Day Saints. This 3.5-acre site offers a significant opportunity to increase stewardship of the area's valuable riparian habitat.

Overall, the acquisition and donation was accomplished with funds from Salt Lake City and Salt Lake County Open Space Programs, a donation from the Church of Jesus Christ of Latter-day Saints, with support from Utah Open Lands, Wasatch Hollow Community Council and Wasatch Hollow Community Association. These lands will be protected through conservation easements, which will identify conservation values to be protected through the near-term design and long-term management of the space, and prevent any residential or commercial development in the future.

3. Overview of Structured Decision Making

This section reviews the use of these structured decision making (SDM) approaches from the perspective of bringing together necessary and multiple perspectives—in either individual or group decision making processes—as part of natural resource management initiatives. A key facet of this discussion is the use of normative benchmarks (i.e., how decisions should ideally be made) as guides for structured decision making processes; these include concepts from multiattribute utility theory (Hammond et al. 1999; Keeney & Raiffa 1993) and decision analysis (Clemen 1996; Keeney 1982; von Winterfeldt & Edwards 1986).

Overall, a SDM approach is best viewed as a kind of decision-focused process that helps people to build understanding of a decision problem or opportunity, and work to overcome common biases as they make choices. A shortlist of the kinds of biases that need to be addressed in order to foster more defensible, higher quality decisions include: (1) the need to recognize, and account for, potentially biased judgmental heuristics (i.e., shorthand decision rules) that people typically utilize when faced with complex choices; (2) the need to balance emotional responses to opportunities, problems, or alternatives alongside more reasoned, deliberative, or technical analyses; and (3) the need to push aside relatively simple characterizations of opportunities, problems, or alternatives that may lead to overly specific or constrained responses. Each of these issues—as well as a host of others—can be addressed through the use of decision structuring tools that help people to more fully define their decision-

specific objectives, identify or understand the available alternatives that are sensitive to these objectives, and then address the often difficult tradeoffs that choosing among alternatives entails (Clemen 1996; Hammond et al. 1999; Kleindorfer et al. 1993).

3.1 Clarifying Objectives and Identifying Alternatives

The critical first element in a SDM process is to engage recipients in a process of thinking carefully about their objectives as they relate to the decision(s) at hand. One aspect of this process ought to help people focus on their values (e.g., the importance of sustainability), which can be expressed, for the purpose of decision making, as objectives (e.g., taking actions that *promote* sustainability). A second aspect ought to help people distinguish between *means* and *fundamental* objectives, which helps to facilitate initial thinking about alternatives through which fundamental, or end objectives, can be met (Keeney 1992).

For example, decisions about open space may focus on providing easy access to students as part of organized classes (e.g., at the primary or middle school level). A SDM process will push this discussion a step further by moving past endorsements of a single alternative (i.e., providing easy access) and will instead prompt people to think about the difference between *means* and *fundamental* objectives. In this case, "providing easy access to students as part of organized classes" is likely a *means* objective, whereas the *fundamental* objective is to provide educational opportunities through open space design and management. Focusing discussion and analysis on fundamental objectives helps bring to the forefront other potential means objectives that are also worthy of consideration in planning (e.g., providing opportunities for field research by graduate students or providing mechanisms for non-formal or adult education). Note that engaging in a process of differentiating means from fundamental objectives does not preclude decision makers from, for example, choosing an alternative that creates access for organized classes of middle school students. It does, however, help people to realize that a single option is not a panacea and that it—as well as others—may be selectively combined (i.e., by combining some and omitting others) in different ways to achieve fundamental objectives.

Beyond helping to widen the range of options that might be considered by decision makers, the process of helping people to identify and clarify *fundamental* objectives, and the alternatives derived from the *means* objectives, serves two other important functions. First, a thorough exploration of management objectives helps to legitimize the much-needed balance between what are traditionally technical concerns (such as restoring or maintaining environmental health) and those that are more values-based (such as respecting long-established property boundaries or building trust among stakeholders and managers). Second, exploring a comprehensive set of objectives at the front end of a decision making process is an important first step toward avoiding many of the problems associated with unaided decision making. For example, considering a wider range of decision-relevant objectives helps decision makers to realize that focusing only on one of its dimensions cannot solve a problem. Likewise, helping an individual or group more fully understand what it is they want to achieve with a given decision places the focus squarely on site-specific objectives and serves to weaken the appeal of business-as-usual patterns of decision making (e.g., following a semi-rigid script that may be followed based on the design and management of other open space areas in Salt Lake City).

3.2 Attaching Performance Measures to Objectives

A frequently ignored aspect of clarifying objectives that will guide a decision is thinking about ways to *operationalize* them. In other words, it is of little help to a decision maker in an open space planning process to express an objective—such as improving the health of the

environment—without also having a clear idea of exactly how to measure it. In order to complete this important step, decision makers must identify the *performance measures* for the objectives that are appropriate; in the example above, therefore, what are aspects of the environment that will be used to estimate improved health, both in the near-term design of the space and the long-term management.

Over the course of our work as researchers, and in our work as consultants on similar kinds of projects, we have found that the process of identifying and agreeing upon performance measures that will be linked to objectives is critical because:

A. The results of associated social, economic, or technical analyses will be more decision-relevant insofar as they are framed in terms of measures that (1) make the most sense to, and (2) are most desired by stakeholders and decision makers; this makes it easier for decision makers and interested and affected parties to follow, recognize, and respond to changes within a managed system over time;
B. Doing so helps to foster greater openness and trust in the overall decision making and longer-term management process;
C. It leads to a higher degree of learning over time about the social, economic, and technical elements of managed systems by all of the parties involved, expert and non-expert alike; and,
D. It helps to foster more defensible and thus, higher quality decisions insofar as they are (1) specific to a well-defined problem, (2) responsive to the objectives and concerns of interested and affected parties, and (3) informed by decision-relevant science.

Generally speaking, performance measures that characterize the different aspects of a system fall into one of three categories:

1. *Natural measures* are direct measures of conditions that exist in a system. For example, if one objective of an open space plan is to minimize the costs of long-term monitoring, then the specific performance measure can be expressed directly in dollars, or more specifically, the expected cost of long-term monitoring.
2. *Proxy measures*, by contrast, are used when it is not possible to directly measure an objective of interest. For example, if one objective is to prevent a decline in community property values, economists may—by proxy—estimate these values under alternative open space plans using a hedonic pricing model. Likewise, there is no single direct measure of environmental health. But, analysts and researchers may develop a comprehensive list of proxy measures; these include—but are clearly not limited to—measures of water quality, productivity, and species diversity.
3. *Constructed measures* are most often used when neither a direct, natural measure nor a reasonable proxy measure exists. Constructed attributes are typically used to operationalize objectives that are psychophysical in nature (e.g., the objective to increase community pride in the open space). Scales that may be administered during surveys often need to be constructed—e.g., by social scientists—as a means of characterizing these objectives.

3.3 Making Tradeoffs and Deciding

Engaging people in a process of identifying what matters to them and what they want to achieve with a decision begs another question: how can people choose which management alternative is “best”? In some cases—such as when only a single objective matters—a single best risk management option can be clearly identified. More often than not, however, many conflicting objectives are in play (e.g., minimizing costs, maximizing safety, protecting the environment,

etc.) and decision makers must realize the inevitability of tradeoffs; the need to give up something valued in order to gain something that is also valued, but for different reasons.

The tradeoffs inherent in choosing one alternative over another are difficult for most decision makers because of the psychological conflict that they evoke (Gregory et al. 2001a). SDM approaches can help in some cases simply by reminding people of the need to address tradeoffs. In other more complex cases, SDM efforts can be designed to provide guidance to decision makers about how to carry out more formal tradeoff analyses. Doing so frequently involves providing decision makers with tradeoff support tools. In their most basic form, these tradeoff tools involve the ranking and weighting of objectives as they relate to expectations about how different risk management options are expected to perform across them.

Objective	Performance Measure	Option 1	Option 2	Option 3
Keep purchase price low	Total Purchase Price ($)	$27,900	$32,500	$39,900
Keep maintenance costs low	Average Annual Maintenance Costs over 10 years ($)	$900	$900	$1,350
Maximize vehicle safety	Safecar.gov Crash Test (Star Rating - Driver)	★★★	★★★★★	★★★★★
	Safecar.gov Crash Test (Star Rating - Passenger)	★★★	★★★	★★★★★
Have adequate interior cargo space	Interior Cargo Volume (square feet)	65	90	75
Be environmentally friendly	Average City/Highway Fuel Economy (MPG)	21 MPG	20 MPG	17 MPG
Drive capably on ice and snow	Drive Train Type	AWD	4WD	AWD
Impress the Neighbors	"Wow" Factor (1-10 constructed measure)	3	6	8

Figure 2. A hypothetical consequence matrix for the purchase of a new car that was shown to participants in the SDM workshops conducted for the Wasatch Hollow Open Space Planning project.

Common to each of these methods is the important concept that the weighting of objectives should only be undertaken in a comparative framework. All too often, decision makers will state that a certain objective—e.g., minimizing the financial costs associated with implementing a management plan—is of paramount importance. Lost in this kind of comparison-free weighting is the important concept of relative benefit. While one may wish to focus on the importance of one objective, decision makers must also be aware of potential large increases in performance on one objective that may be accompanied by relatively small decreases in performance on another (e.g., a great increase in environmental protection may be worth the relative small increase in cost). A starting point during tradeoff analysis is, therefore, the construction of a matrix where the objectives and attributes form the rows of a matrix, and the various alternatives are displayed across the top (Figure 2). The expected performance—or *consequence*—of each alternative is then modeled (e.g., Costanza & Voinov 2004) or predicted (e.g., Failing et al. 2004; Keeney & von Windterfeldt 1989) and displayed in the individual cells of the matrix. This systematic presentation of how well the different alternatives satisfy each objective, known as a consequence matrix, is a powerful tool for clarifying the acceptability of different options and is useful as the starting point for the in-depth consideration of tradeoffs and conflict across objectives.

Following the construction of a consequence matrix, decision makers must determine the relative weight that should be placed on each objective when comparing alternatives. This is a critical aspect of a SDM approach because it helps to clarify what different tradeoffs will mean in terms of the outcomes associated with the selection of one alternative over another.

Objective	Performance Measure	*Worst* Possible Performance	*Best* Possible Performance	Rank (1-7)	Weight (0-100)
Keep purchase price low	Total Purchase Price ($)	$39,900	$27,900	_____	_____
Keep maintenance costs low	Average Annual Maintenance Costs over 10 years ($)	$1,350	$900	_____	_____
Maximize vehicle safety	Safecar.gov Crash Test (Star Rating - Driver)	★★★	★★★★★	_____	_____
	Safecar.gov Crash Test (Star Rating - Passenger)	★★★	★★★★★		
Have adequate interior cargo space	Interior Cargo Volume (square feet)	65	90	_____	_____
Be environmentally friendly	Average City/Highway Fuel Economy (MPG)	17 MPG	21 MPG	_____	_____
Drive capably on ice and snow	Drive Train Type	4WD	AWD	_____	_____
Impress the Neighbors	"Wow" Factor (1-10 constructed measure)	3	8	_____	_____

Figure 3. A hypothetical weighting form adapted from Figure 1 for use during swing weighting for a decision about the purchase of a new car.

In *swing weighting*, for example, decision makers are presented with only the best and the worst projected consequences associated with each objective and told to assume that they are faced with a situation where the alternative they are evaluating possesses all of the worst consequences (i.e., it costs the most, performs poorly in terms of environmental protection, etc.). They are then asked to identify which of the objectives they would most want to "swing" from its current worst condition to the best possible condition in order to make the largest improvement to the system (Figure 3). Decision makers repeat this procedure for all of the objectives in the set (i.e., after assigning a rank of one to the objective they most want to improve from worst to best, they are asked to think about the next objective they would most want to improve from worst to best and rank that as a two, and so on until all are ranked accordingly). Once all of the objectives have been ordered in this way, decision makers are typically asked to assign 100 points to the highest ranking objective with the others assigned a relative percentage of this weight. A weight of zero may be assigned to swings on objectives from worst to best that are judged to be irrelevant to the decision at hand (Baron 2000; Clemen 1996). For example, decision makers should assign a weight of zero where there is no difference in real or perceived value between the worst and best performance, essentially canceling that objective and removing it from further discussion. Assigning weights in addition to ranks is useful in terms of helping respondents to identify objectives that are critically important as compared to objectives that may be no more or less important than others.

After respondents have completed the swing weighting exercise, they should be directed to review, compare, and evaluate the alternatives that are under consideration (e.g., the alternative

open space plans created for the Wasatch Hollow Open Space). Each alternative should be accompanied by a "report card" that depicts its expected level of performance across all of the objectives elicited from stakeholders. This way, respondents can quickly and easily cross-reference their own ranks and weights (determined during the swing weighting procedure) with the available alternatives. In other words, a respondent's ranks and weights should help direct them to their ideal alternative.

4. Methods

Our involvement in the Wasatch Hollow Open Space planning project began during the fourth quarter of 2009. At this time, we worked with the Open Space Lands Program for Salt Lake City to establish and define the decision environment that was the focus of the stakeholder involvement initiative (see below). At this time, we agreed to treat the proposed 10-acre site as a single unit for discussion purposes (rather than dealing with the different phases of open space separately). However, we left open the possibility that, through our subsequent discussions with different stakeholders, there may be an opportunity (or need) to apply different design and management plans to different areas of the open space.

At the same time, we also worked with the designated Conservation Easement Holder (Utah Open Lands) and the Open Space Lands Program to identify a list of groups that we would ask to take part in a first round of stakeholder meetings. Since the number of stakeholders was large, and because we were told of a history of potentially diverging opinion between different stakeholder groups, we elected to meet with similar groups of stakeholders separately. The stakeholder groups we ultimately identified included:

- Representatives of the Salt Lake City Corporation (e.g., members of the Salt Lake City Council, Office of the Mayor, Salt Lake City Police, the Open Space Lands Program, Parks, etc.);
- Community members living around the northern reaches of the proposed open space (including members of the Wasatch Hollow Community Council);
- Community members living around the southern reaches of the proposed open space (including members of the Wasatch Hollow Community Council);
- Neighboring institutions[1] (e.g., representatives from Westminster College, the Church of Jesus Christ of Latter-Day Saints, and the Wasatch Presbyterian Church);
- Representatives of the Salt Lake City Open Space Board, Salt Lake County and Utah Open Lands; and
- Content area experts (which included ecologists, ornithologists, planners, and engineers).

After we identified the relevant stakeholders, we convened a series of stakeholder workshops with each of these aforementioned groups, which took place during the week of 18 January 2010. During each workshop, the consultants (Arvai and Wilson) led a facilitated discussion of participants' concerns and objectives, as well as alternative means by which these concerns and objectives could be addressed. Under the terms of our contract with the city, the key focus at this stage was to help participants distinguish between means and fundamental objectives.

Each workshop also focused on establishing performance measures for the concerns and objectives that were discussed. The workshops ended with participants providing general

[1] Following our work on the project, additional meetings were held with representatives from Clayton Middle School and Rocky Mountain Power.

comments and nominating others who should be invited to take part in the planning process. Following these workshops, the consultants analyzed the comments made by participants and constructed objectives-based value trees (see below). Value trees graphically depict the relationship between higher order objectives (fundamental) and sub-objectives (means), and include information about suggested performance measures.

We did not give more weight in our analysis to certain objectives, nor did we omit any means or fundamental objectives that were discussed by workshop participants. Rather, our goal at this stage of the process was to account for all of the objectives shared by participants in all of the workshops. Any omissions from this report are unintentional and are most likely the result of a particular concept being mentioned only in passing.

5. Findings: Objectives and Performance Measures

Participants in the workshops were nearly unanimous in their identification of 5 fundamental objectives for the design and management of the Wasatch Hollow Open Space, which were that:

1. The ecology of Emigration Creek, the riparian corridor, and the adjacent open space area be restored and protected;
2. The boundaries that exist between the Wasatch Hollow Open Space and adjacent private properties be clearly defined and respected by all parties (e.g., users of the open space, private property owners, and agents of Salt Lake City);
3. The extent and type of public access that is permitted in the Wasatch Hollow Open Space be informed primarily by environmental and restoration considerations;
4. Public safety be enhanced, and associated risks reduced, as they relate to both the Wasatch Hollow Open Space and the adjacent private properties; and
5. Coordination and collaboration between different stakeholder groups be enhanced and fostered during both the planning and implementation (design and management) of the Wasatch Hollow Open Space area.

Two additional fundamental objectives that were discussed at length in many of the workshops, primarily involving experts and decision makers, included:

1. The use of an adaptive management framework to guide the long-term monitoring and management of the Wasatch Hollow Open Space area; and
2. The need to keep the budget for both the design and long-term management within a reasonable margin.

Findings related to each of these fundamental objectives, including workshop participants' views on how they may be achieved (i.e., means objectives) are outlined in more detail below.

5.1 Ecological Restoration and Protection

Perhaps the most widely cited and discussed fundamental objective regarding the design and long-term management of the Wasatch Hollow Open Space area dealt with the need to restore and protect the natural ecology of Emigration Creek, the riparian corridor, and the adjacent open space area. In terms of the means by which this objective could be achieved, workshop participants were once again unanimous in their view that restoring and protecting the natural environment in the open space meant addressing existing impacts and impairments as they relate to water quality in Emigration Creek, habitat for terrestrial and aquatic wildlife, and the health and composition of native vegetation (Figure 4).

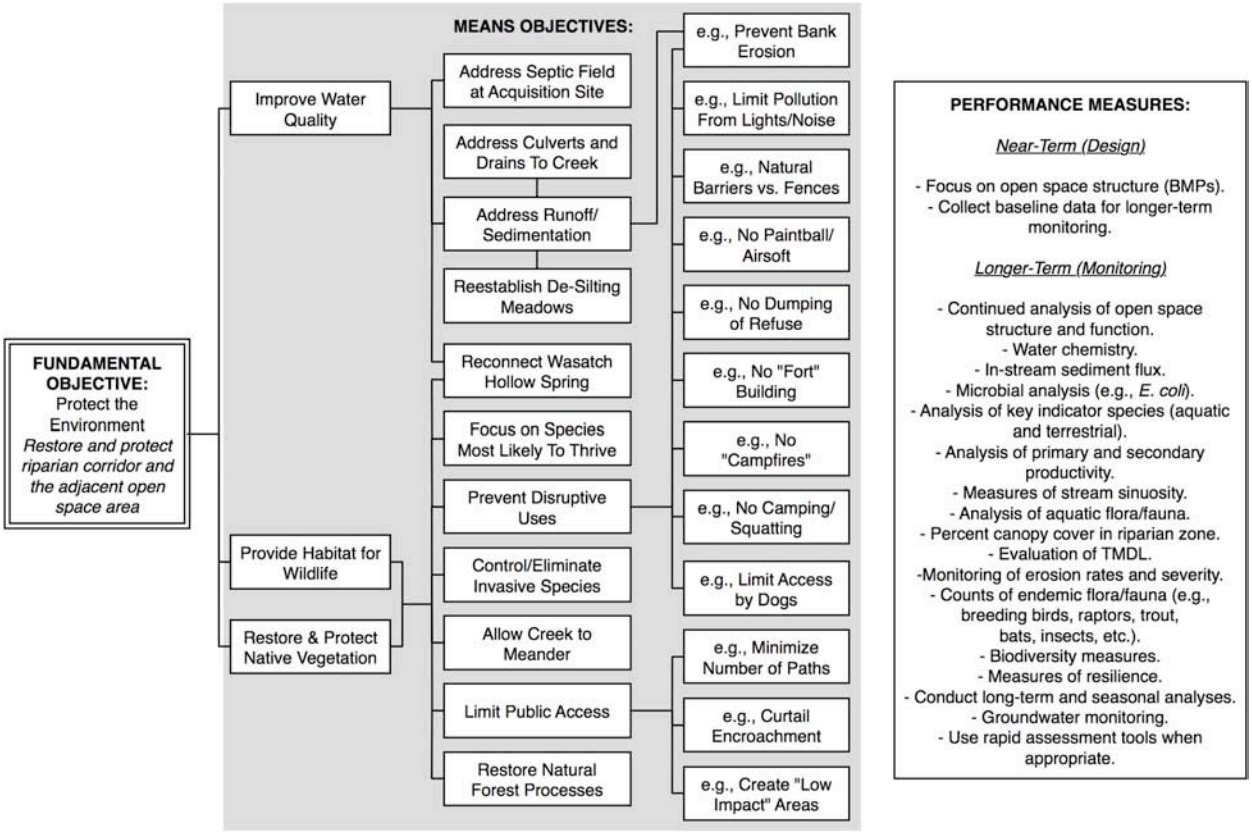

Figure 4. Value tree depicting the relationship between the fundamental and means objectives, and suggested performance measures, for the restoration and protection of the ecology of Emigration Creek, the riparian corridor, and the adjacent open space area.

In terms of lower-order means objectives for improving water quality, participants frequently discussed the need to reconnect natural springs within the Wasatch Hollow Open Space area to Emigration Creek. They also discussed frequently the need to address runoff and sedimentation (e.g., of pesticides, fertilizers, and other materials) from adjacent areas. Related to this objective, workshop participants also discussed the need to address existing city drains and culverts that may empty into Emigration Creek and nutrient loading from the septic field that is present near the empty, city-owned house located at the acquisition site. Finally, there was also discussion, primarily among ecologists and engineers, about the need to both prevent further erosion through bank restoration and stabilization alongside Emigration Creek, and to reestablish de-silting meadows within the Wasatch Hollow Open Space area.

Regarding the means objectives for restoring and protecting habitat for wildlife as well as native vegetation, much of the discussion about lower-order objectives addressed both simultaneously. For example, reconnecting natural springs within the Wasatch Hollow Open Space area to Emigration Creek was touted by many as a means of providing better habitat for in-stream flora and fauna, and of providing surrounding native vegetation with better environmental conditions. The same was true for other means objectives, including the restoration of natural forest processes (e.g., leaving some amount of leaf litter and deadwood in place); allowing Emigration Creek to meander naturally through the Wasatch Hollow Open Space; removing and controlling invasive species; and focusing restoration activities on those species most likely to thrive naturally in an open space area surrounded by a large urban population.

Another important means of restoring and protecting habitat for wildlife as well as native vegetation that was discussed by many workshop participants was to limit public access. This was a sensitive issue for many as it was widely accepted that a public open space would need to allow for some public access. However, it was also a widely held value that the Wasatch Hollow Open Space not be "loved to death". To this end, lower-order means objectives that were provided as examples by many workshop participants included designating certain parts of the Wasatch Hollow Open Space as "low-impact" areas, curtailing encroachment of private property into the open space area (including the possibility of instituting buffer zones between the native species in the open space and non-native species that may be present on private property), and minimizing the number of paths that may be installed for visitors.

Finally, there was much discussion about the necessity of eliminating disruptive uses (from the standpoint of environmental protection and restoration) of the open space area. There was unanimous agreement about the need to eliminate the dumping of trash and refuse in the area (by visitors to the open space and adjacent property owners), campfires, as well as camping and squatting. The majority of workshop participants also discussed the installation of natural barriers as opposed to human-made barriers (i.e., fences) if or when these were deemed necessary; the primary reason behind this means objective was the need to provide opportunities for species to move freely within or through the open space corridor. Artificial noise and lighting within the Wasatch Hollow Open Space was also a concern expressed by several stakeholders.

Many workshop participants also discussed other disruptive uses that ought to be eliminated; these included the staging of paintball or "airsoft" battles because of concerns about the paint and debris, and because it is believed that the brightly colored "airsoft" pellets may be confused for berries by native birds and other species. Related to these activities, several workshop participants discussed the need to curtail excessive noise and the building of "forts".

Finally, and importantly, there was widespread agreement about the need to limit access to the Wasatch Hollow Open Space by dogs. It was widely understood that this would be viewed as a controversial means objective by many observers. Nevertheless, it was a strongly held view by most that open access to dogs throughout the entirety of the open space was inconsistent with the restoration objectives that had been discussed. There was nearly unanimous agreement that, in the areas where dogs may be allowed, strict on-leash rules be enforced. There was also nearly unanimous agreement that, in certain areas of the Wasatch Hollow Open Space, dogs should not be permitted. Many other public open space areas in North America have adopted such a policy.

In each of the workshops we conducted, time was also devoted to a discussion of the kinds of performance measures that could be used to determine if objectives related to the restoration and protection of Emigration Creek, the riparian corridor, and the adjacent open space area were being met. Many of these performance measures came out of our discussions with technical experts (e.g., ecologists); however, other, non-expert participants also suggested several potential performance measures (Figure 4).

It is our belief that a more detailed discussion of performance measures, likely involving ecologists and other environmental scientists, needs to take place. In our workshops, we heard from many the opinion that best mid-succession management practices (BMPs) and structural indicators should drive the initial design of the Wasatch Hollow Open Space. However, over time, environmental monitoring (both long-term and seasonal) within the Wasatch Hollow Open Space should include parameters such as water quality (including microbial analysis), key

indicator species, secondary productivity within Emigration Creek, stream sinuosity, erosion rates, sediment flux, breeding bird surveys, canopy cover, and counts of endemic (vs. invasive or exotic) flora and fauna.

5.2 Establish Clearly Defined Boundaries

Another widely cited fundamental objective dealt with the boundaries that exist between the Wasatch Hollow Open Space and adjacent private properties. Workshop participants felt strongly that the boundaries between public and private property must be clearly defined in the Wasatch Hollow Open Space design, and that the long-term management plan needs to ensure that these boundaries are respected by all parties (e.g., users of the open space, private property owners, and agents of Salt Lake City). In terms of the means by which this objective could be achieved, participants felt that respecting boundaries required protecting both private and Open Space property through the near-term design and management of the space, as well as by ensuring regular monitoring to prevent boundary violations over the long-term (Figure 5).

In terms of lower-order means objectives for protecting private property, participants frequently discussed the need to reduce risks associated with liability by preventing trespassing onto private property from the public space. Participants also discussed the need to establish difficult-to-access buffer zones (e.g., built of natural barriers such as dense foliage) between the Wasatch Hollow Open Space and adjacent landowners. Though this objective could probably be achieved within the exiting open space area, some workshop participants brought forward the idea that buffer zones could be made larger by the City purchasing land from neighboring landowners to increase the buffer on the open space side (particularly along those sections of the open space property where Emigration Creek crosses back and forth several times between the public and private space). A similar option involved allowing neighboring landowners to purchase land from the Wasatch Hollow Open Space area (or the Church of Jesus Christ of Latter-Day Saints prior to their making the 3.5-acre donation); in this scenario, private landowners could take steps to create their own expanded buffer zones between the public space and their existing property boundaries (particularly along the northern section of the space).

Related to these previous objectives, participants also mentioned the need to protect private property values, an objective that could be at least partially achieved by protecting the aesthetic value that the Wasatch Hollow Open Space provides to adjacent landowners, limiting noise in the open space, and allowing only non-disruptive activities (i.e., by prohibiting paintball, air-soft, camping, etc.). Finally, some participants talked about the need to forbid the annexation of private property, including annexation for the current Wasatch Hollow Open Space plan, or for future open space initiatives along the Emigration Creek corridor.

Many workshop participants also talked about the need to establish clear boundary lines as a means to protect both private and open space property. It was suggested this could be achieved by designing signage that is educational, as opposed to regulatory in nature, and implementing natural barriers as opposed to manmade barriers (e.g., using vegetative barriers as opposed to chain link fencing as discussed previously). In addition to establishing clear boundaries, participants felt that preventing encroachment of private property into the Wasatch Hollow Open Space was an important means of protecting the natural ecology and integrity of the area. The forms of encroachment that participants felt needed to be prohibited were the dumping of landscaping refuse in the open space, as well as personal or recreational use of the open space area by adjacent landowners, particularly if public recreational use is forbidden or limited.

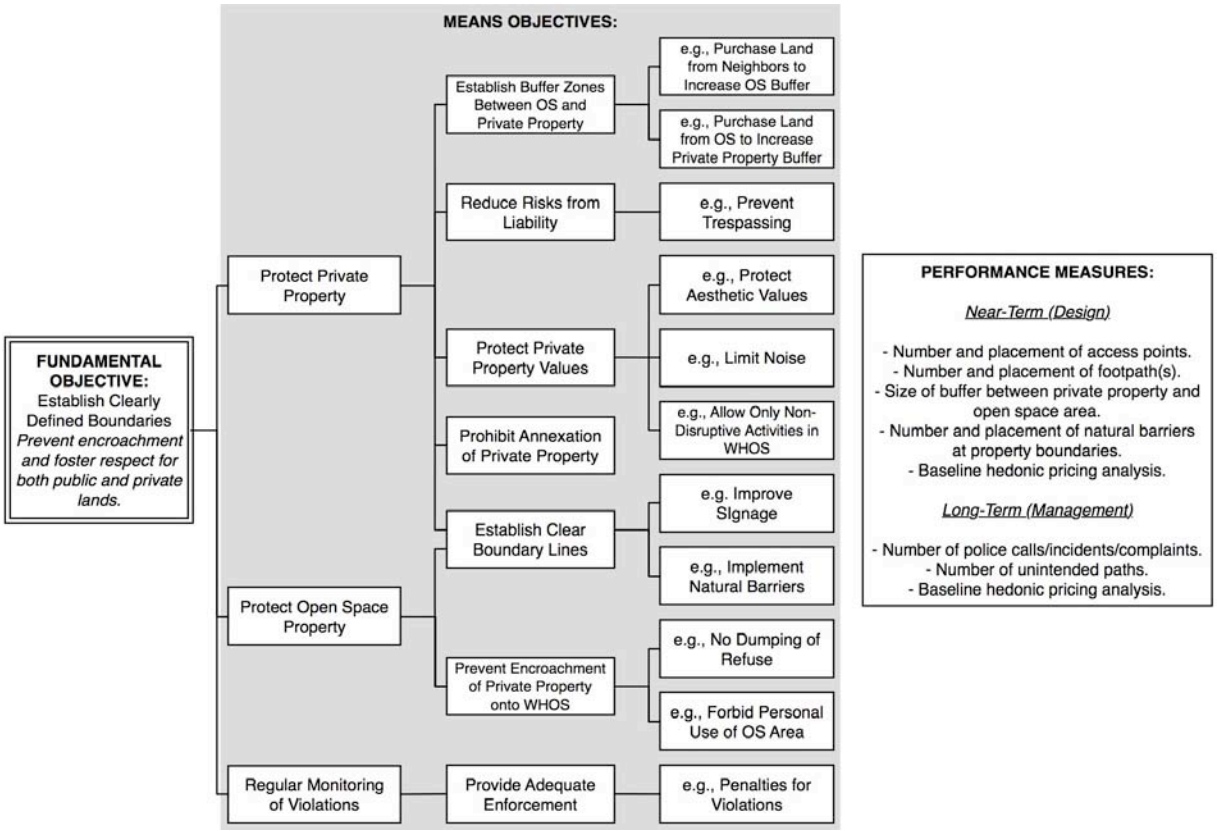

Figure 5. Value tree depicting the relationship between the fundamental and means objectives, and suggested performance measures, for establishing clearly defined boundaries between private and public lands.

In addition to accounting for the protection of private and open space property through clearly defined boundaries, workshop participants felt that regular monitoring of the defined boundaries was necessary in order to identify and prevent violations. It was a commonly shared opinion that boundaries would not be respected without adequate enforcement and penalties for violations.

In terms of these objectives, workshop participants were asked to suggest performance measures that would ensure that clearly defined boundaries were established, protecting both private and public property and ensuring regular monitoring to prevent and penalize violations. It was suggested that the near-term design could be evaluated in terms of the number and placement of access points, number and placement of footpath(s), the size of buffers between private property and open space, number and placement of natural barriers as property boundaries, and the use of a baseline hedonic pricing analysis to measure the effect of the open space plan on private property values. Participants also suggested that the long-term enforcement of property boundaries could be evaluated by the number of police calls/incidents/complaints having to do with boundary violations, the number of unintended or new paths created that cross the boundary lines, and a regular analysis of property values linked to the management of the open space.

5.3 Provide Limited Public Access Informed by Restoration Goals

Another fundamental objective identified by the majority of participants, and mentioned at least

as often – if not more often – than the issue of establishing property boundaries, was the objective of providing limited public access. Workshop participants sometimes differed on the types of activities they felt were appropriate, but there was large-scale agreement that the extent and type of public access should be informed primarily by environmental and restoration considerations. Ultimately, this resulted in widespread agreement that access should be *limited* (i.e., by not allowing unencumbered public access across the entire 10-acre space and, instead, limiting public access to only certain portions of the open space area). In terms of exceptions to this objective, workshop participants were unanimous in their view that unrestricted access should be provided for research (though it was pointed out that footpaths would not be necessary for researchers to gain access to desired areas within the open space). And, although not unanimous, a majority of workshop participants also talked about providing educational access to the entire 10-acre site. Open public access was also discussed; however, much of this discussion was couched in terms of providing broader access in the southern reach of the Wasatch Hollow Open Space area (Figure 6).

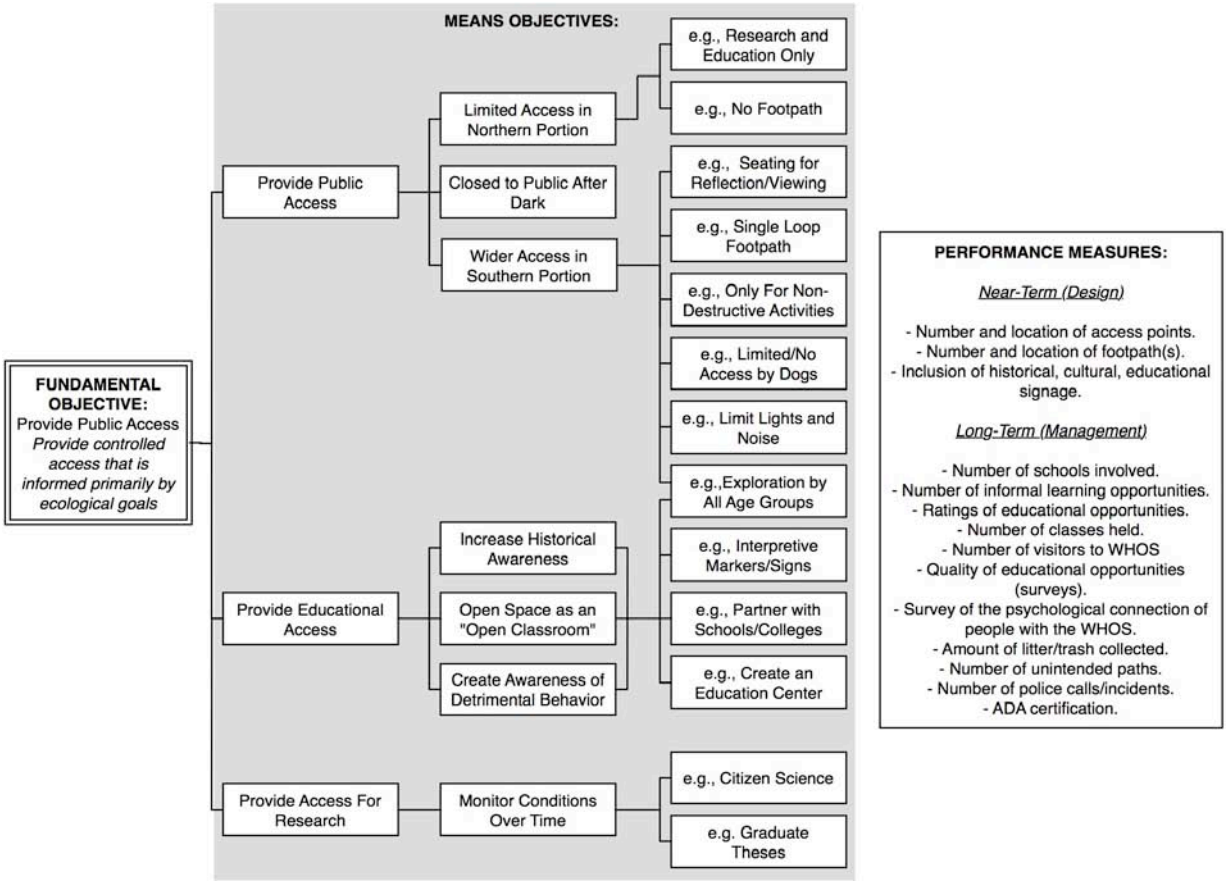

Figure 6. Value tree depicting the relationship between the fundamental and means objectives, and suggested performance measures, for providing public access to Wasatch Hollow.

In terms of lower order means objectives for providing public access, participants frequently discussed the need to limit public access in the northern portion of the Wasatch Hollow Open Space area (i.e., the area that is the subject of the donation by the Church of Jesus Christ of Latter-Day Saints); one way to achieve this objective is to not install a footpath in this part of the Wasatch Hollow Open Space area. Such a policy would serve to discourage potentially destructive public access and would help to protect the research and educational value of the space. However, workshop participants were nearly unanimous in their agreement that wider

access be permitted in the southern aspect of the open space, possibly with a looped footpath through the restoration area. Workshop participants also discussed the need to close the open space to the public after dark.

The type of access that was discussed as appropriate in the northern portion of the space focused on research and education, but not recreation. Access in the southern portion of the space was still discussed by the majority as needing to be limited in an attempt to protect ecological value while still meeting the Salt Lake City Open Space Program mandate of public use. Suggested types of access for passive recreation included the construction of a single loop path (see above), and seating for reflection and wildlife viewing. Participants also discussed the need to only allow for non-destructive activities (e.g., by prohibiting paintball, camping, etc. that might harm habitat or wildlife), limit lights and noise in the space, and prohibit or at the very least limit access by dogs.

A very small minority of workshop participants (specifically, only 3 people we spoke with over the course of our time in Salt Lake City) mentioned more active use of the entire Wasatch Hollow Open Space area in a manner that is more consistent with the use and access provided by more traditional "parks" (e.g., by constructing an amphitheatre, sports fields and courts, etc.).

Regarding the means objective of providing educational access, much of the discussion about lower-order objectives revolved around increasing historical awareness, using the open space as an "open classroom" and creating a greater awareness of the impacts of detrimental behavior. Many participants discussed the historical significance of the space and the need to document that history through interpretive markers and signage in the space. The historical significance was mentioned as both cultural (i.e., related to early settlement of the area) and ecological (i.e., related to ecological features that no longer exist such as the clay cliffs). Participants also discussed the idea of the open space as an outdoor classroom, whereby partnerships with nearby schools and colleges would allow for students to be brought to the space to learn about the natural environment. Related to this idea of the open space as an outdoor classroom, some participants discussed creating an educational center that could serve to structure educational programs, and provide indoor educational space in the winter.

Related to both providing educational access and providing limited public access, some participants felt that Wasatch Hollow should be used to encourage all age groups to explore nature, as long as this exploration was not ecologically detrimental. It was believed that exploration in open space is crucial to learning about and developing an appreciation for the natural world. Finally, many participants discussed the need to create and promote awareness of the negative impacts that detrimental behavior has on the space. It was believed that much of the behavior leading to negative ecological impacts (e.g., damming the creek, creation of new walking paths, off-leash dogs, etc.) could be prevented if people better understood the impact that such activities have on wildlife and their habitat. It was suggested that user friendly (vs. overly legal or regulatory), informational signage would be one means of creating this awareness.

Finally, workshop participants were unanimous in their support for providing access for research, specifically in order to monitor conditions over time. It was believed that if the near-term design of the space includes the restoration of the stream and riparian area, research by graduate students at local colleges and universities would allow for the short- and long-term success of those restoration efforts to be measured and communicated back to the communities using the space. Local citizens could also be engaged in the research process, promoting citizen science and community education at the same time.

Regarding performance measures for providing public access, workshop participants suggested both near-term and long-term measures of success. In the near-term, participants suggested that the number and location of access points, number and location of footpath(s), the inclusion of historical, cultural and educational signage, and whether or not the space is ADA certified be used to evaluate alternative open space designs. In the long-term, participants suggested that the management of the space be evaluated in terms of the number of schools or students involved in educational efforts, the number and quality of informal learning opportunities presented to visitors, visitor ratings of educational opportunities, the number of visitors, measures of the psychological connection of people with the open space (through visitor use and community surveys), the amount of litter collected, number of unintended paths created by visitors, and the number of police calls/incidents.

5.4 Reduce Risks to the Public, Private Property Owners, and Salt Lake City

The majority of workshop participants identified reduced risk and increased public safety as a fundamental objective for the design and management of the Wasatch Hollow Open Space area. Increasing public safety was important from the perspective of reducing risks on both public and private land. In terms of the means by which this objective could be achieved, participants talked largely about enhancing overall public safety in and around the Wasatch Hollow; many participants also discussed the importance of reducing the risk of liability to landowners and other responsible parties (Figure 7).

In terms of lower-order means objectives for enhancing public safety, participants frequently discussed the need to curtail illegal activity in the Wasatch Hollow Open Space area (e.g., the sale and use of illegal drugs, squatting, etc.), as well as to provide adequate enforcement to ensure this activity remains low over time. A potential means of curtailing illegal activity included removing the abandoned house, which is perceived by many as an attractant for trespassers and illegal acts. However, many participants also discussed the importance of legitimate public access to and use of the open space as a means of both “flushing out” illegal activity as well as decreasing the attractiveness of some areas of the open space that are currently difficult to access for legitimate uses.

Some participants also discussed the adoption of principles from the Crime Prevention through Environmental Design (CPTED) philosophy. CPTED is touted as a multi-disciplinary approach to deterring criminal behavior by changing the built, social and administrative environment (see http://www.cpted.net/). It is unclear, however, if CPTED as it is practiced in many cities and municipalities can be made consistent with the kinds of restoration objectives outlined above. Beyond CPTED and wider public access in certain areas, workshop participants frequently discussed the need to adequate enforcement in Wasatch Hollow, which includes regular walkthroughs of the open space by community members, as well as increasing police or security patrols.

In terms of lower-order means objectives for promoting community stewardship and co-management, participants frequently discussed involving neighboring property owners as well as the local community, local youth organizations (e.g., scouts), visitors to the Wasatch Hollow Open Space area, educational institutions, and neighboring churches. It was suggested that neighboring property owners be engaged by helping them to develop management plans for their property (e.g., by incorporating more native species into their landscaping). It was also suggested that all individuals and organizations mentioned previously be involved through regular wildlife counts, clean-up days, on-going research opportunities, regular walkthroughs of

the open space, and opportunities to act as informal docents, educators, or interpreters. It was also suggested that the City and the community improve coordination with the easement holder(s) (i.e., Utah Open Lands), and other previously mentioned stakeholders, to ensure that the open space is managed according to conservation goals and maintained as such in perpetuity.

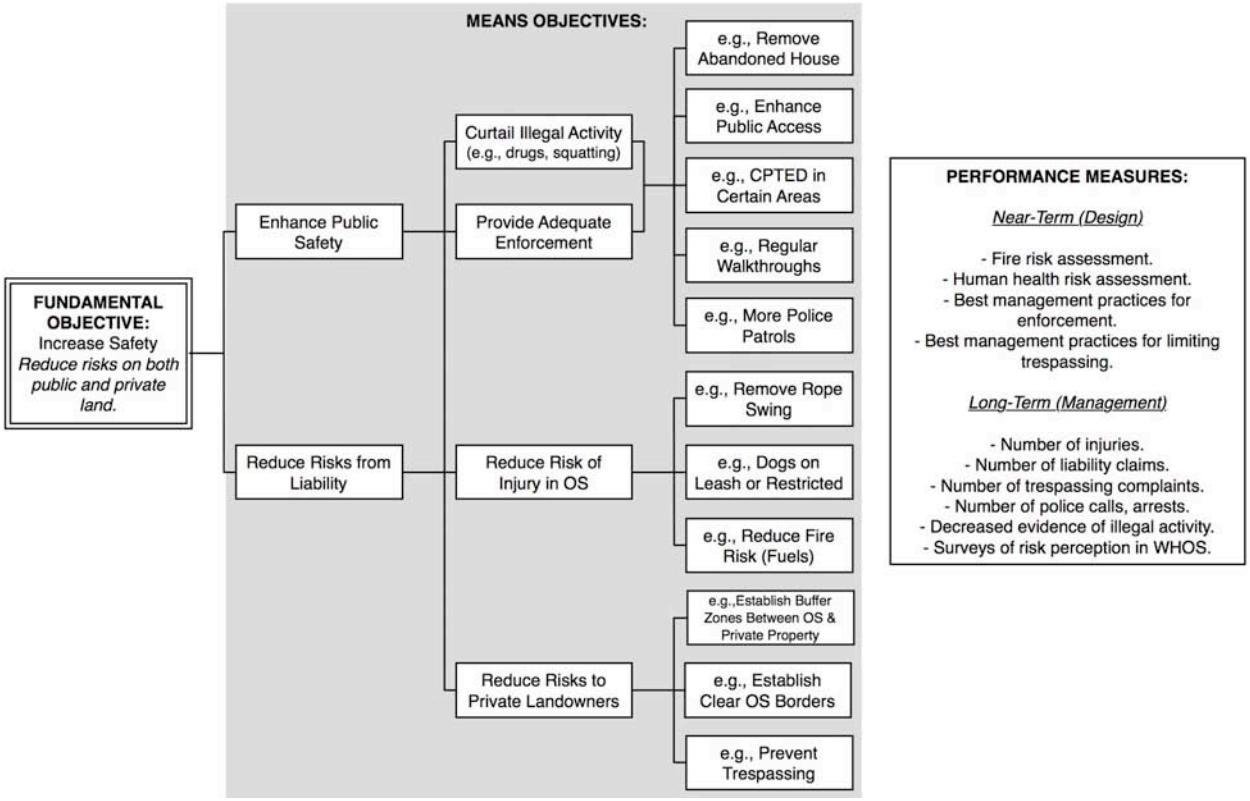

Figure 7. Value tree depicting the relationship between the fundamental and means objectives, and suggested performance measures, for reducing risks to health and safety on public and private land.

Lower-order means objectives for reducing risk of liability included reducing the risk of public injury in the Wasatch Hollow Open Space area, as well as reducing risks to private landowners. Potential means of reducing risk of injury in the open space (which was viewed by most as a source of potential liability to the city, and managers of the open space) included removing the rope swing to prevent physical injury to visitors, requiring that dogs be leashed or restricted in other ways so as not to be a threat to other visitors to the open space, and managing fuel loads in order to minimize the risk of wildland fire. The potential for fire was mentioned both as a potential risk within Wasatch Hollow, but also a potential risk to homeowners living adjacent to the space.

Potential means of reducing risks to private landowners included establishing buffer zones between the Wasatch Hollow Open Space area and private property, establishing clear open space borders, and preventing trespassing on private property. All of these means of reducing risks to private landowners could be established through the means suggested previously in the section on establishing clear boundaries.

Regarding performance measures for increasing public safety, workshop participants suggested both near-term and long-term measures of success. In the near-term, participants suggested

that the design be evaluated in terms of assessed risk of fire, assessed risk to human health, and the use of best management practices for ensuring enforcement and limiting trespassing. In the long-term, participants suggested that the management plan be evaluated in terms of the number of injuries over time, number of liability claims, number of trespassing complaints, number of police calls and arrests, evidence of illegal activity, and perceived risk associated with the Wasatch Hollow Open Space area (through community or public surveys).

5.5 Foster Collaboration and Cooperation

A fifth fundamental objective for the design and management of Wasatch Hollow dealt with the need to foster cooperation and collaboration between different stakeholder groups during both the planning and implementation (design and management) of the open space area (Figure 8).

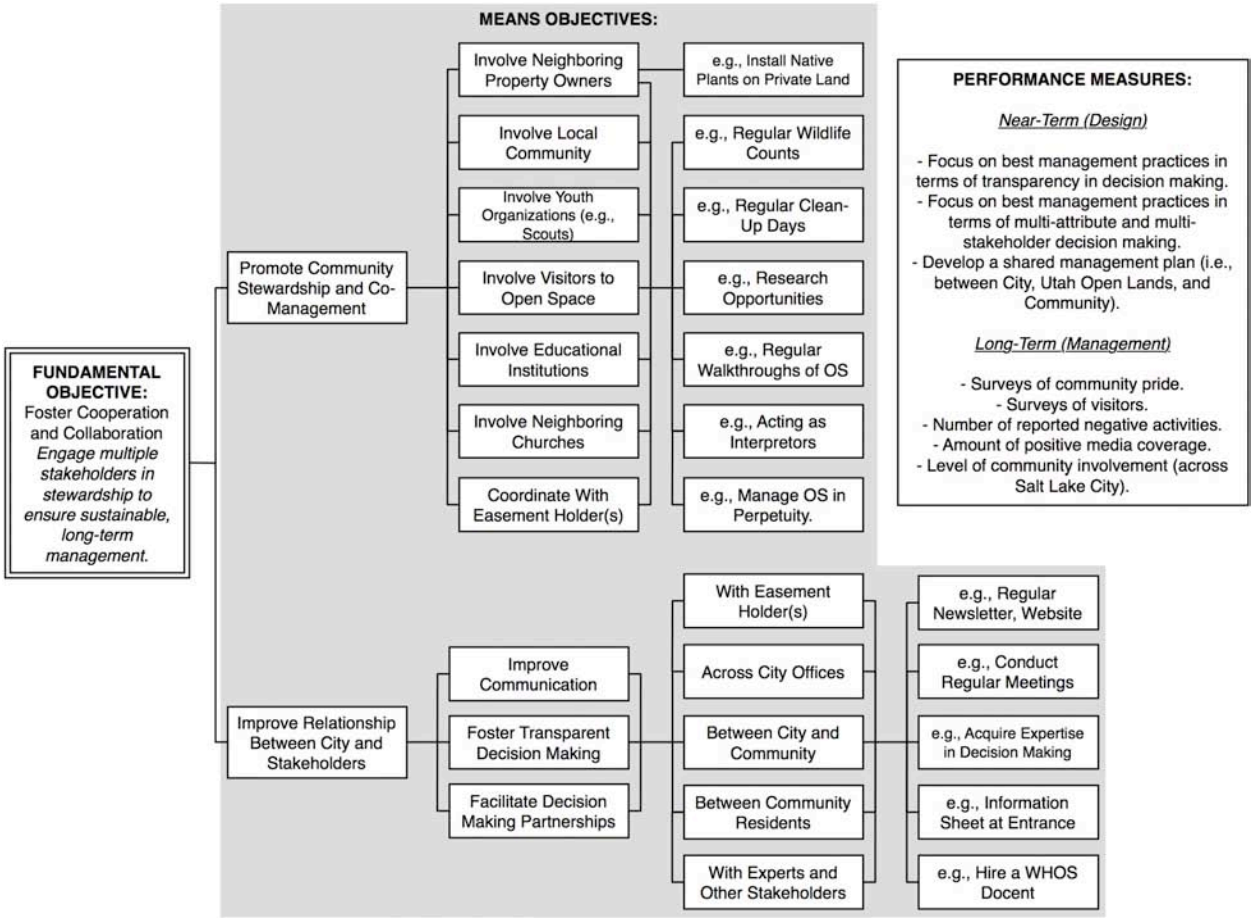

Figure 8. Value tree depicting the relationship between the fundamental and means objectives, and suggested performance measures, for fostering cooperation and collaboration among multiple stakeholders.

In terms of the means by which this objective could be achieved, workshop participants were unanimous in their view that community stewardship and co-management should be promoted in Wasatch Hollow. A majority of participants also mentioned the need to mend relationships among various stakeholders (in particular between the City and other stakeholders).

Regarding means objectives related to improving the relationship between stakeholders, participants frequently discussed the need to improve communication, foster transparent

decision making, and facilitate decision making partnerships. It was suggested that these improvements were necessary between the city and multiple stakeholders, including the easement holders, the community and local experts. It was also suggested that these improvements were necessary across city offices and between community residents. Potential means for achieving these improvements are through regular newsletters updating stakeholders about the design and management process, a Wasatch Hollow Open Space website, regular meetings with stakeholders, the acquisition of training or expertise in multiattribute decision making at the City level, providing information sheets at the entrance to the open space, and hiring a formal docent to facilitate educational and research opportunities.

Workshop participants identified multiple near-term and long-term measures of performance for cooperation and collaboration as it relates to the Wasatch Hollow Open Space area. In the near-term, participants suggested that the open space design be evaluated by the incorporation of best management practices in terms of transparency in decision making and the use of multi-attribute and multi-stakeholder approaches to decision making, as well as the presence of a shared management plan (i.e., between the City, Utah Open Lands, and the community). In the long-term, participants suggested that the Wasatch Hollow management plan be evaluated via surveys of community pride in the space, surveys of visitor attitudes and perceptions, the number of negative activities reported, the amount of positive media coverage, and the level of community involvement across the City.

5.6 Implement an Adaptive Management Framework

Many workshop participants, expert and public alike, discussed the need to manage the Wasatch Hollow Open Space area in a "holistic manner". When asked to clarify the meaning of a holistic approach to management, many participants cited the need to (1) clearly establish responsibility for stewardship and monitoring, and (2) develop a management framework that would maintain Wasatch Hollow as a natural, undeveloped open space in perpetuity.

However, several other important themes were discussed in each workshop. For example, many participants discussed the need to manage the Wasatch Hollow Open Space area in a manner that is sensitive to its place within the broader Emigration Creek Watershed. When pressed to discuss this further, many participants talked about the need to manage for the kind of ecology (including plant and animal species, as well as structural conditions) that are most likely to thrive in this Wasatch Hollow Area; recognizing that (1) the structure and function of the Wasatch Hollow ecosystem may be quite different from the structure and function present in other open space areas and (2) structure and function will likely change over time.

Along similar lines, participants discussed the need to include both a long-range temporal and spatial element in the restoration and management of the open space. From a spatial standpoint, many participants discussed the need to conceptualize Wasatch Hollow as only one part of the overall composition of natural areas in Salt Lake City. Many participants appropriately took this view further to discuss the Wasatch Hollow Open Space area itself as containing a network of possibilities in terms of both restoration and access possibilities. The specific examples that were discussed in this context included the desire that Wasatch Hollow be designed and managed differently from other open space areas in the city (e.g., several participants noted that, just because an activity is permissible in other open space areas, it may not be permissible in Wasatch Hollow if it compromises the restoration goals of the site). This idea extended to Wasatch Hollow itself with several participants noting that, pending an ecological evaluation of the overall open space, public access or types of permissible activities that make sense in one area of the open space may not make sense in another.

From a temporal standpoint, the goal of long-range monitoring and management, as discussed by many, is the need to learn about the overall health of the Wasatch Hollow ecosystem and its responses to various kinds of human impacts. Building further on this theme, some participants in the public and expert groups wanted how the open space area is managed over time to be flexible in response to the changing needs of the ecosystem.

We must be clear at this point that workshop participants did not discuss these potential changes in terms of allowing development at some point in the open space. Instead, many of the examples given by workshop participants dealt with learning over time; for example, closing certain areas of the open space to public access if it was determined over time that the current management structure was compromising the health of the ecosystem. A similar example was discussed in the context of access for dogs; if (a) dogs were permitted in parts of the open space and (b) it was determined that access by dogs was negatively affecting the ecosystem, then this access would be removed from the list of permissible activities. Some participants discussed the possibility that public access and the list of permissible forms of access could also be expanded in certain areas of Wasatch Hollow if these areas were deemed to be robust and relatively insensitive to certain types of use. We would characterize these themes as the need to apply "adaptive management" to the area. (Indeed, some experts in one of our workshops mentioned the appeal of an adaptive management framework for Wasatch Hollow.)

The concept of adaptive management was born out of the need to address the objective of learning about managed environmental systems over time (Holling 1996; Walters 1986). The central argument of adaptive management is that management decisions are really research questions that masquerade as answers. The management of complex environmental problems then can be regarded as a process of learning over time from policies designed to reduce uncertainty and improve the managed system's ability to respond to inevitable environmental, social, or economic surprises. To operationalize this effort, adaptive management calls for the design and implementation of carefully planned and monitored management "experiments", with analysis and comparison of management initiatives at appropriate spatial and temporal scales. In other words, rather than making one-time decisions on the basis of the best existing knowledge (as many may be tempted to do at Wasatch Hollow), adaptive management regards policy decisions as being part of a carefully planned, iterative, and sequential series of steps that emphasizes monitoring and learning as the system changes, both in response to external stimuli and in response to human impacts (Walters 1986).

Because of its experimental basis[2] (in that sequential management initiatives are designed, implemented, and monitored), adaptive management is quite different from more conventional management models based on trial-and-error. Prescriptively, an adaptive management approach involves four primary elements (Walters 1986):

1. Bounding of the management problem in terms of objectives and constraints;
2. Characterizing existing technical knowledge about the managed system;
3. Designing flexible management plans (i.e., that allow for modification over time); and
4. Embracing the potential failures within the management plan as a means to learning and improving long-term outcomes by making mid-course corrections.

[2] Adaptive management should not be confused with the precautionary principle. Although the precautionary principle also involves taking action to reduce current or potential risks about which little may be known (Raffensperger & Tickner 1999), it does not call for the experimental comparison of alternative management initiatives as a means of reducing uncertainty. In this way, the precautionary principle is best viewed not as a substitute for adaptive management, but rather as a philosophy that underlies and may help to encourage certain kinds of management intervention.

It is our view that adaptive management as a guiding objective for the Wasatch Hollow Open Space area may have significant theoretical and practical appeal. As a result, the City may wish to incorporate this management model into the Wasatch Hollow Open Space plan. Because adaptive management is a guiding philosophy (vs. a specific management alternative), performance measures were not elicited for this objective.

5.7 Maintain Design and Management Costs Within Appropriate Limits

The cost of designing and managing the Wasatch Hollow Open Space was, surprisingly, discussed relatively infrequently. When it was discussed during our workshops, it was often characterized as a function of other means and fundamental objectives. For example, some participants discussed project costs in terms of having sufficient resources on hand to carry out a broad restoration effort, or to build or renovate a possible education center. Other participants discussed cost in terms of the need to have sufficient financial resources available for enforcement or monitoring efforts.

When we asked about budgeting for Wasatch Hollow, we were informed that financing for the open space would be determined after a basic restoration and management framework was established. This is a sensible approach. However, this approach makes it imperative during the planning process that the costs of alternative open space designs (including restoration and long-term management) be established and evaluated alongside the other objectives identified above.

To this end, we would urge Salt Lake City and its open space partners to adopt a fundamental objective related to keeping management costs within "reasonable limits"; limits that may only be determined through this planning process by the City and any other identified outside supporters of the Wasatch Hollow Open Space project. It is our experience that maintaining a reasonable cost structure for both restoration and management provides the greatest opportunity for other fundamental objectives to be met. Specifically, it would be problematic for the City and its partners in this process to set overly ambitious and costly targets for restoration or public access at the start of the project, only to see these go unmet if adequate funding cannot be maintained in perpetuity. The worst-case scenario is the creation of an unfunded mandate in the form of an open space project that, inevitably, would fall into a state of ecological and social decline, coupled with the inability on the part of the City and the community to implement a long-term management plan.

6. Findings: Alternatives

Our goal when we became involved in this planning process was to work closely with members of the project team (based in the Salt Lake City Open Space Program) to organize information obtained from our stakeholder meetings into *components* of possible alternative designs for the Wasatch Hollow Open Space Area. We emphasize components of alternatives because, in our experience, the development of fully conceptualized alternatives (i.e., comprised of multiple components) is best left to the next project team working in concert with local stakeholders and experts who—together—are often in better tune with on-the-ground realities and constraints (e.g., budget limitations, regulatory constraints, local ordinances, etc.). To be clear, we are not suggesting that each the following items *should* be represented in the final, adopted plan for the Wasatch Hollow Open Space area. Instead, we are suggesting that these components be considered as part of a wide range of different alternatives that stakeholders, experts, and decision makers representing the City have the opportunity to evaluate in a side-by-side

comparison during future meetings of the planning group.

6.1 Alternative Open Space "Clusters"

By "clusters", we mean different open space designs and management plans implemented in different areas of the 10-acre Wasatch Hollow Open Space site. There was widespread agreement among participants in our workshops that it may be beneficial to open the southern reaches of Wasatch Hollow to wider public access while maintaining a stricter stance on access in the northern portion. The presence of a footpath that leads people away from the northern areas of Wasatch Hollow coupled with the presence of natural barriers at the southern end of the property currently owned by the Church of Jesus Christ of Latter Day Saints may serve as an effective barrier, thereby preventing the need for human-made barriers such as fencing.

Considering design options that offer different strategies for the northern and southern aspects of Wasatch Hollow may be beneficial for several reasons. First, providing more strict protections (e.g., by not including a footpath in the area of the open space that is the subject of the donation by the Church of Jesus Christ of Latter Day Saints) would likely offer a greater sense of security to private property owners who (a) live adjacent to this part of the open space and (b) seem to be more concerned about trespassing when compared with residents adjacent to the areas in Wasatch Hollow that currently see more regular public use. Restricting access to the northern portion of Wasatch Hollow (e.g., to researchers and for certain educational uses) without the construction of a footpath may lead some who currently oppose the Wasatch Hollow Open Space expansion to throw their support behind the project.

Second, "splitting" Wasatch Hollow into two management clusters would provide ecologists with an opportunity to study the effects of human impacts (in a public open space setting) on riparian areas. Having the northern aspect of the open space serve as a "control" against which measurements in the south may be compared may inform both the design of potential new open space areas (i.e., outside of Wasatch Hollow) while also providing additional insights into the adaptive management of Wasatch Hollow itself (see above).

Third, characterizing the northern portion of Wasatch Hollow as a restricted use area may help the site better achieve some of its restoration goals. For example, a limited access site may serve as an effective refuge for species—flora and fauna—that may be quite sensitive to even minimal human use.

6.2 Access by Dogs

There was nearly unanimous agreement—even among the most ardent dog owners—that allowing unrestricted access to Wasatch Hollow by dogs would likely stand as an affront to the restoration goals expressed by all. To this end, alternative plans for the Wasatch Hollow Open Space should explore different dog policies with the impacts of these policies studied in terms of being able to meet the objectives expressed during this planning process. For example, what would a restricted dog policy mean for the ability of Wasatch Hollow to meet its restoration and safety objectives? Though there would almost certainly be opposition expressed by some, it is our view that the planning process for Wasatch Hollow should explore the option of heavily restricting (i.e., strictly-enforced on-leash regulations) or prohibiting dogs in the active restoration areas of the open space. As we note above, many other public open space areas in North America have adopted such a policy.

When discussing the issue of dogs specifically, many participants noted that unrestricted access

to dogs—even leashed dogs—should not be considered for the Wasatch Hollow Open Space just because other open space sites (e.g., Miller Park) allowed them. In fact, many participants cited the opportunity to take dogs to other open space areas nearby as a reason for, perhaps, forbidding dogs entirely from Wasatch Hollow.

6.3 Buffer Zones

In the workshop with community members living around the northern reaches of the proposed open space, there was much discussion of the importance of buffer zones. As we note above, buffer zones were thought of as a means of both promoting restoration goals and protecting private property.

Our understanding of these discussions is that buffer zones are essentially widened boundary lines that increase the proverbial "no man's land" between public and private property. Such buffers could be created on public or private property, but in both cases the intent would be to increase the space between public and private land with the hope of ensuring public use in public space, and private use in private space. These buffer zones could be comprised largely of dense foliage (vs. human-made barriers like fencing) that would serve to separate the open space area from adjacent private properties. Handling buffer zones in this way would likely prevent many adjacent property owners from installing fencing, which in turn, would be beneficial for maintaining the integrity of the wildlife corridor that is Wasatch Hollow.

We believe, based on findings from our workshops, that the creation of buffer zones might proceed in several ways. One the one hand, buffer zones could—in many places—be built into the existing 10-acre open space site. In other cases, it may be possible for the City or the Church of Jesus Christ of Latter-Day Saints to sell small slivers of the property to private land owners providing that they agree, in turn, to install a natural buffer zone. The reverse is also true in that some private landowners might sell slivers of their existing properties to the City providing that it agrees to install a natural buffer zone.

We recognize that the framework for creating these buffer zones may be complex and will likely need to be established on a case-by-case, property-by-property basis. Nevertheless, because buffer zones seem like they may address many objectives simultaneously, we suggest that the pros and cons of these be discusses with stakeholders and considered as part of the alternative design and management structures created for Wasatch Hollow.

6.4 Abandoned House

The abandoned house that currently sits on the portion of the site recently acquired by the City came up in conversation on several occasions, but was not a large focus of the conversation in any particular group. Some participants suggested that the house be renovated and used as an educational or nature center, perhaps providing permanent space for a non-profit organization or full-time Wasatch Hollow Open Space docent. Many who supported this idea felt that it would be a shame to tear down a structure if there was a way to incorporate it into the space. However, many who shared this opinion also recognized that if it was not financially feasible (from a design or management standpoint) then perhaps such a center could be built elsewhere.

Although some participants supported the idea of keeping and renovating the house, others clearly felt that it was best that it be torn down. Supporters of this idea were not necessarily opposed to the idea of a nature center on site, but rather felt that the cost associated with

restoring and maintaining the house was unreasonable. There were additional concerns shared regarding the impact of the septic system on water quality in the Hollow, as well as the challenges associated with access to the house, both in terms of parking and proximity of the house to the main entrance.

It is our recommendation that both options be considered, but that in the evaluation of alternative designs and management plans that the costs associated with restoring and maintaining the house be communicated, along with the costs associated with removing the house from the space in a manner that is consistent with the overall restoration and environmental protection objectives of the open space area. The house should be considered as just one means of providing an educational/nature center; clearly if such a center is desired there may be other means to achieve that goal.

6.5 Types of Uses

The question of whether or not to provide public access was addressed by all of the stakeholder groups. Some groups were clearly in favor of prohibiting access, while others were supportive of providing some public access through a variety of uses. However, even those who would prefer no access in the space indicated support for limited access and use, if that access and the types of uses encouraged were informed by restoration goals and perhaps limited to certain segments of the space. Very few individuals expressed support for active use of the space (e.g., bikes, organized sports, etc.).

Given that public access in some form is likely to occur in order to be consistent with the Open Space Program goals and mission, it is our suggestion that various passive forms of use be considered for incorporation in the space (e.g., walking, wildlife viewing, reflection, etc.). Such uses are consistent with ecological restoration goals aimed at providing wildlife habitat, protecting water quality, preventing erosion, and the like. In addition, such uses are unique from those that may be allowed in more traditional park settings, setting apart the type of use provided by an open space area from other more traditional outdoor spaces.

Another benefit of encouraging appropriate, passive use of the space would be the potential for such use to drive out elicit or illegal activities that currently occur. Research suggests that encouraging legitimate use of an outdoor urban space facilitates “natural surveillance” (over active surveillance, such as the deployment of security cameras, which was not favored by the majority of workshop participants we spoke with), essentially discouraging offenders from using the space and improving public perceptions of the space in the process (Knutsson 1997). Encouraging appropriate passive use has the potential to increase safety, while not creating the ecological harm that more active, or inappropriate uses, may bring.

6.6 Footpaths

The inclusion of footpaths could promote the passive use described above. However, as with the case of open space clusters and access by dogs, we suggest that stakeholders, experts, and decision makers representing the City evaluate options with differences in the number and placement of footpaths within the Wasatch Hollow Open Space area. Specifically, alternative designs (e.g., looped trails, the presence or absence of bridges), placement (within the open space), and number (single or multiple trails) should be considered in terms of their influence on meeting some of the five fundamental objectives outlined above.

For example, many workshop participants conjectured about the role of footpaths in terms of

enhancing or detracting from public safely, meeting restoration goals, and encouraging respect for the boundaries between public and private property. Arguments were made both in favor and in opposition of footpaths across these objectives. Given the importance of footpaths for meeting the City's mandate of public access in open spaces, we suggest that both views be considered carefully during the planning and decision making process.

6.7 Rope Swing

The rope swing that is currently located within the Wasatch Hollow Open Space poses problems for many of the fundamental objectives discussed by workshop participants. For example, significant erosion of the stream bank is evident as a result of swing use. Also, use of the swing has prompted noise complaints from neighbors and likely poses a significant risk of liability for the City. For these reasons, it is our suggestion that alternative open space designs *not* include the rope swing over Emigration Creek. Although the swing does hold cultural and perhaps even historical significance to some members of the Community, the majority of participants recognized that some traditional uses of the space might not be appropriate given the goals of the Open Space program.

6.8 Utilities, Drainage, and Flood Control

Some participants, in particular those in the expert and City stakeholder groups, discussed issues surrounding access to utilities in the Hollow, drainage points along the Creek, and the need to provide adequate flood control. Some participants expressed that alternative designs need to account for adequate access for maintenance and provision of these services, while others shared the concern that such access and services might be detrimental to ecological restoration and management objectives.

It is our suggestion that alternative design options explore the possibility of moving utilities out of the Wasatch Hollow Open Space area, or burying lines during any initial restoration effort. Such an alternative may eliminate the need for potentially destructive access by Rocky Mountain Power. However, given that power lines may still remain, alternative designs should also consider how to provide adequate access while protecting ecologically sensitive areas.

Alternative designs should also explore the possibility of moving culverts and drainage points to protect the ecology of Emigration Creek. In addition, given concerns by a few participants about flooding, it is our suggestion that natural flood control mechanisms be explored as aspects of potential alternatives. It was shared by some participants that any concern about flooding could be mitigated through ecological engineering efforts such as the creation of de-silting meadows, or stream and bank restorations that would minimize the need for human flood control interventions.

6.9. Educational and Research Partnerships

Workshop participants were very supportive of partnering with local educational institutions to both provide research opportunities for graduate students and help monitor conditions in the Wasatch Hollow Open Space area. Alternative design and management plans should incorporate means of reaching out to and working with colleges, universities, and government agencies to encourage collaborative research in Wasatch Hollow and at surrounding sites. Such partnerships could include social and behavioral research (e.g., surveys of visitor use, surveys of community perceptions of the Wasatch Hollow Open Space area), bio-physical research (e.g., assessments of water quality, soil quality), and ecological research (e.g., bird

surveys, biodiversity indices). Not only would these partnerships be a positive use of the open space, but linking the Wasatch Hollow Open Space area into new and ongoing research efforts could help to offset the cost of monitoring changes in environmental and social conditions, and evaluating the effectiveness of the current design and management plan.

6.10 Enforcement

Almost all of the workshop participants shared concerns about enforcement, whether it was in regard to public safety in the Wasatch Hollow Open Space area, trespassing across private-public property lines, or appropriate use. As a result, it is our recommendation that the design and management plans under consideration explore the effectiveness and cost of alternative enforcement regimes (e.g., increased police patrols, private security, and community-based initiatives). The design of the Wasatch Hollow Open Space area should consider access for enforcement, while any proposed management plan should account for the cost and effectiveness of different types of enforcement over time.

7. Next Steps: Presenting Alternatives, Confronting Tradeoffs, and Deciding

As we note in Section 3.3, we suggest that participants in the decision making process for the Wasatch Hollow Open Space area be asked to first set priorities across seven fundamental objectives outlined above prior to evaluating any of the presented management alternatives. As we note above, it is our view that the first five objectives be the focus of future stakeholder-based sessions with the latter two objectives geared towards panels of experts and City decision makers. The alternatives presented to respondents should be accompanied by a "report card" (Figure 9) that depicts its expected level of performance across all of these objectives. This way, respondents may evaluate, with relative ease, the available alternatives in light of their own priorities.

The method we propose for the Wasatch Hollow Open Space planning process is a combination of swing weighting and approval voting. Swing weighting is described in Section 3.3 and will encourage respondents to consider the kinds of tradeoffs that they are willing to make across their objectives. Further, this process—if structured appropriately—will lead respondents to the alternatives best suited to their ranked order of objectives. Approval voting is a simple task where respondents are asked to identify all of the alternatives that they would find to be acceptable to them.

Data collected from swing weighting with approval voting can be used in several ways. Information about respondents' ranks and weights can be used to summarize areas of agreement and disagreement across stakeholders in terms of the objectives that are most important to them during the planning process. Similarly, this information may be used to identify alternatives, or aspects of alternatives, that are broadly acceptable to the range of people involved in the planning process; this is especially important if a new, hybrid alternative should be created to combine the best aspects of two or more alternatives. Finally, under ideal circumstances, the combined swing weighting and approval voting process may reveal a small subset of alternatives that are acceptable to all involved. Oftentimes, these widely acceptable alternatives are nobody's first choice. However, it is often the case that individuals' second-ranked alternative is widely accepted across all respondents. If this is the case, it may be possible to implement this alternative as-is, or modify it slightly so that it becomes even more acceptable to a broader spectrum of respondents.

	Objective	Performance Measures	Rating of Alternative Under Consideration	Overall Rating For Objective
Stakeholders, Experts, & Decision Makers	1. Ecological Restoration and Protection	e.g., Anticipated health of Emigration Creek	Low…High	Composite Score or Letter Grade
		e.g., Anticipated health of fauna	Low…High	
		e.g., Anticipated health of flora	Low…High	
	2. Establish Clearly Defined Boundaries	e.g., Anticipated effect in neighboring property values	Negative…Positive	Composite Score or Letter Grade
		e.g., Presence/absence of multiple footpaths, access points	Multiple Paths Present…Absent	
	3 Public Access Informed by Restoration Goals	e.g., Types of activities permitted	Passive…Active	Composite Score or Letter Grade
		e.g., Expected quality of visitor experiences	Low…High	
	4. Reduce Risks to the Public	e.g., Number or severity of anticipated injuries	Few…Many	Composite Score or Letter Grade
		e.g., Risk associated with liability	Low…High	
		e.g., risk of wildland fire	Low…High	
	5. Foster Collaboration and Cooperation	e.g., Extent of collaboration during design	Low…High	Composite Score or Letter Grade
		e.g., Extent of collaboration during management	Low…High	
Experts & Decision Makers	6. Consistent with an Adaptive Management Framework	e.g., Extent of flexibility in open space design	Low…High	Composite Score or Letter Grade
	7. Cost	e.g., Cost to design and implement	Low…High	Composite Score or Letter Grade
		e.g., Cost to manage over time	Low…High	

Figure 9. Example of the type of "report card" that may accompany each alternative. The performance measures and rating scales presented are examples; final performance measures and rating scales should be determined in consultation with experts and stakeholders. An overall report card should also be prepared to compare all of the available alternatives within a single framework.

However, in suggesting swing weighting and approval voting, we realize that logistical difficulties may prevent the Salt Lake City Open Space Program from implementing this process to its fullest. Even in the absence of swing weighting however, we strongly suggest that alternative open space plans be characterized in terms of the objectives they are designed to frontline. In other words, a hypothetical *Plan A* could be characterized as the most restoration-oriented option that also has significant benefits for protecting private property (e.g., because of the inclusion of buffer zones). A hypothetical *Plan B* could be characterized as the most access-oriented option that, as a result, does not perform as well on some restoration indicators. A hypothetical *Plan C* could be characterized as a hybrid model, and so on. This way, respondents can quickly align their preferences with the open space option that best suits them.

Approval voting could then be conducted with follow-up analysis devoted (if necessary) to identifying a hybrid option that would be satisfactory to most. Prior to proceeding, this hybrid option should then be presented to respondents for final review and discussion prior to being advanced to Salt Lake City Council.

It is important to note at this point that, even after a process like this, it is unlikely that the chosen alternative will satisfy everybody equally. In terms of the final outcome, there will be those that feel like winners in a process like this, and those that feel like losers. However, it is important that the process through which the final decision is made be not only transparent but also meaningful. Participants must be given the opportunity to think about their objectives in light of the available alternatives and, if necessary, suggest alternative means by which important objectives can be realized. However, we would not support a position taken by any respondent or stakeholder group that none of the alternatives are suitable without them suggesting alternative means by which objectives may be achieved. As we note above, there was broad agreement regarding the seven fundamental objectives outlined above. Out of respect to Wasatch Hollow and the community, these objectives ought to be used as the guideposts during the decision making process that will follow.

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WASATCH HOLLOW
EMIGRATION CREEK CORRIDOR
BASELINE DOCUMENTATION

January 26, 2007

Prepared by

Arthur E. L. Morris

for

Utah Open Lands

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The baseline documentation was developed by actual site visits by Wasatch Hollow Community Association and Utah Open Lands Ecological Consultant, Arthur Morris. Kathlyn Collins of Salt Lake County Public Works Department Engineering Division provided excellent data and photographs of Emigration Creek conditions from the Salt Lake County Emigration Creek Level III Channel Stability Study, 2005. Additional data was obtained from sources cited in the document. This Baseline Documentation is to be used in conjunction with Wasatch Hollow conservation easement(s).

LIST OF PHOTOS

Photo Credits: The name of the photographer is noted in the caption for each photo (first initial and last name). Many thanks to the photographers for their excellent photos. Photos were provided by Anne Cannon, Glenda Cotter, Dan Jensen, and Diane Fosnocht: Wasatch Hollow Community members. And by Kathlyn Collins: Planning Assistant, Water Resources Planning and Restoration, Salt Lake County Public Works Department Engineering Division. Photos from K. Collins in this baseline document were taken during Salt Lake County Engineering Division Emigration Creek Level III Channel Stability Study 2005.

BASELINE DOCUMENTATION

PROPERTY LOCATION AND IDENTIFICATION

Map

Land Type

The open land described in this baseline documentation is the Emigration Creek corridor in Wasatch Hollow. The Emigration Creek corridor in Wasatch Hollow comprises approximately 15 acres, extending from Wasatch Hollow Park (1650 East 1700 South) upstream past Clayton Middle School to 1900 East and approximately 1400 South, Salt Lake City, Utah. The stream corridor includes Emigration Creek and the stream valley up to the crest of the valley walls. The portion of Emigration Creek corridor in Wasatch Hollow is environmentally valuable as an unusually large contiguous section of Emigration Creek corridor with geomorphology similar to the native condition and remnants of native plant communities. Although stream corridors are naturally long landscape elements, the Emigration Creek corridor has been fragmented by urbanization along its length in Emigration Canyon and Salt Lake Valley. Wasatch Hollow contains approximately 1 km of relatively natural Emigration Creek corridor.

This large natural area along Emigration Creek in Wasatch Hollow presents valuable educational, aesthetic, recreational, and social opportunities. These opportunities are particularly unique in an urban context. The stream corridor is within a few blocks of Westminster College, Highland High School, Clayton Middle School, and Uintah Elementary School. Ecologically, the stream corridor is currently unique for its large size and remaining natural habitat. The large size of the corridor in Wasatch Hollow presents opportunity for natural stream and riparian processes that contribute to clean water, preservation of native plant communities, and which are particularly important for birds (Gardner, Stevens & Howe. 1999. Utah DWR Publication No. 99-38).

Ownership of the land in the Wasatch Hollow stream corridor is divided among private individuals, Salt Lake City, the Church of Jesus Christ of Latter Day Saints, and Rocky Mountain Power. Private individuals hold more than 40 parcels of land at least partially in the stream corridor. Private individuals hold 6 parcels that together completely span the stream corridor just west of where 1800 E would transect the corridor. Salt Lake City also owns land completely spanning the corridor: Phase III of Wasatch Hollow Community Park and the 1700 E right-of-way (see map). Besides the private land spanning the corridor at 1800 E and Salt Lake City property at 1700 E and just south of 1700 E, no other type of property ownership (individual, corporate, or public) spans the corridor. Management decisions in the Wasatch Hollow stream corridor will therefore affect numerous landowners. Wasatch Hollow Community members who do not live adjacent to the stream corridor are also important stakeholders. Many Wasatch Hollow

Community members—particularly children—will be directly affected by decisions regarding land management in the stream corridor.

Elevation of the stream bed ranges from 4,478 ft at 1700 East to 4,584 ft. at 1900 East (elevation data from SL County Engineering Division Level III Channel Stability Study. 2005; attached). The crest of the valley walls is a maximum of approximately 30 m above the stream bed, as east of the 1700 East right-of-way. Valley walls are steep, with slopes often 45% or steeper. Of particular note for restoration is the valley wall between 1700 E and Phase III of Wasatch Hollow Park, which is steeply sloping due to road fill. Stream valley geomorphology varies over the length of the corridor in Wasatch Hollow, as is desirable in a natural system.

Floodplain extent is relatively limited; the lateral extent of the valley bottom ranges from 0 m beyond the bankfull channel margins to approximately 70 m at the widest portion (on the current LDS Church property). Floodplain connectivity with the channel is limited because of advanced incision of much of the channel, especially in the downstream portions of Wasatch Hollow. Terraces exist in and near the channel in some places, providing desirable floodable land where they exist.

Three general belts of similar environmental conditions occur along the length of the corridor: 1) running water, 2) riparian, and 3) upland fringe. Running water occurs as Emigration Creek, which may be augmented by flows from natural springs in Wasatch Hollow. Riparian habitat is marked by lowland riparian communities. The upland fringe is marked primarily by mountain shrub communities.

History

The Emigration Creek corridor in Salt Lake Valley formed as the waters of Emigration Creek and floods shaped alluvial fill at the mouth of Emigration Canyon and in Salt Lake Valley. When the Mormon pioneers entered the grassy Salt Lake Valley they reported Emigration Creek flowing in a steep-sided ravine that gradually moderated further west in the valley.

The Donner-Reed emigrant company probably followed the southwestern side of the Emigration Creek corridor from the mouth of Emigration Canyon through what is now Wasatch Hollow before continuing westward through the valley. Wagons of the first group of pioneers of the Church of Jesus Christ of Latter Day Saints (LDS Church, Mormons) followed the Donner-Reed route along the southern side of the Emigration Creek corridor through what is now Wasatch Hollow before camping at approximately 1700 S and 500 E on their first night in the valley (July 22, 1847). The next day they backtracked approximately one mile (possibly to avoid marshy ground), and traveled north to City Creek where they established the camp that would later become Salt Lake City. The next day (July 24), the LDS Church leader Brigham Young and the last of the initial pioneer company entered the valley along the same route, traveled along the side of the Emigration Creek corridor through what is now Wasatch Hollow, crossed

Emigration Creek probably near where the group had crossed the day before (thought to be at about 1100 East), and then continued to the City Creek camp. (R. Dixon. 1997. Utah Historical Quarterly 65(2):155-164)

Wasatch Hollow housing development began primarily in the early 1900's. By 1930, there were several houses on the high land adjacent to the stream valley, as well as one farm where Wasatch Hollow Park now occurs. Fruit orchards extended into the corridor as far as the southern end of the current LDS Church property. Subdivision adjacent to the corridor occurred until approximately the 1970's.

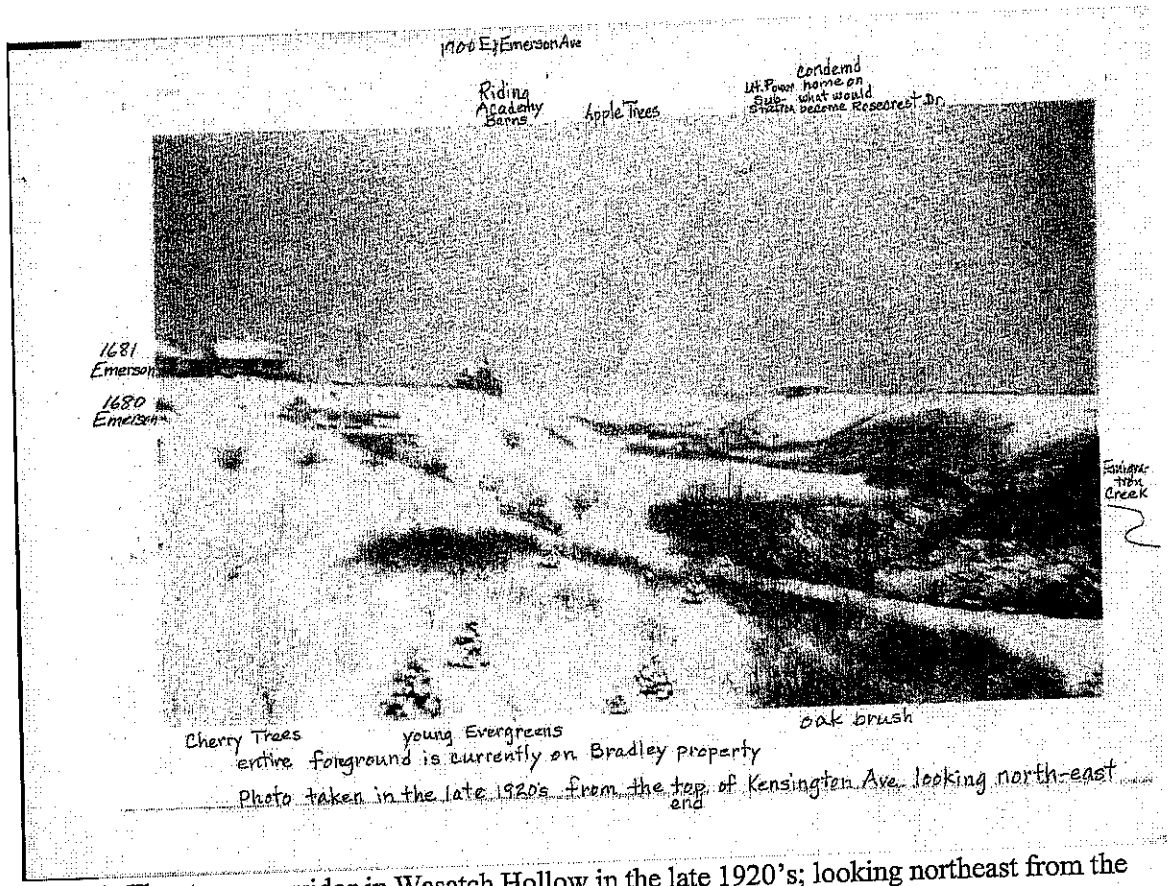


Photo 1. The stream corridor in Wasatch Hollow in the late 1920's; looking northeast from the end of Kensington. (A. Cannon)

In the early 1900's, an underground pipeline was constructed from springs in the Emigration Creek corridor in Wasatch Hollow to the Utah State Penitentiary. This source of fresh water was utilized by the penitentiary until about 1950. The pipeline still exists although it has been abandoned. The springs have been covered by fill from adjacent residential development and fill of the current Bradley property.

Rocky Mountain Power (previously Utah Power) owns land in the stream corridor just west of 1900 E. A substation was constructed on Rocky Mountain Power Company land in the stream corridor sometime in the mid 1900's. This substation still operates.

The Church of Jesus Christ of Latter Day Saints built a stake center (Hillside Stake) that was completed in 1960 on 1900 East at approximately 1400 South with a rear parking lot adjacent to or partly in the Emigration Creek corridor. The LDS Church Colonial Hills meeting house was completed in 1953 on the west side of the corridor at approximately 1450 South on 1700 East. Although the LDS Church owns approximately 5 acres of land in the stream corridor adjacent to the Colonial Hills meeting house (see map), the only apparent development of this land consists of a dirt ramp for vehicular access from the parking lot to the bottom of the stream valley. This ramp is currently gated and padlocked. Chain-link fences have been erected and currently exist along the crest of the stream corridor on the edge of the current Colonial Hills parking lot and around the Hillside Stake Center parking lot.

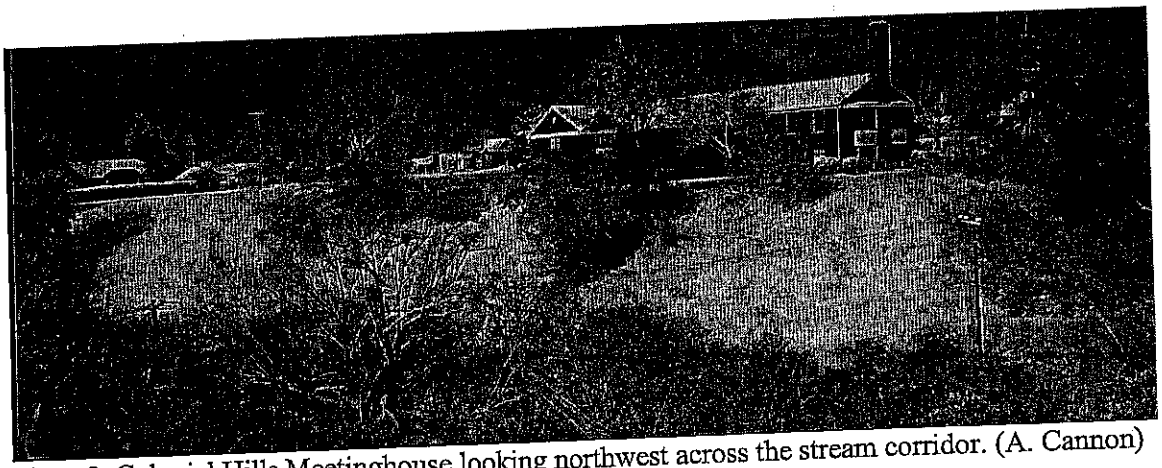


Photo 2. Colonial Hills Meetinghouse looking northwest across the stream corridor. (A. Cannon)

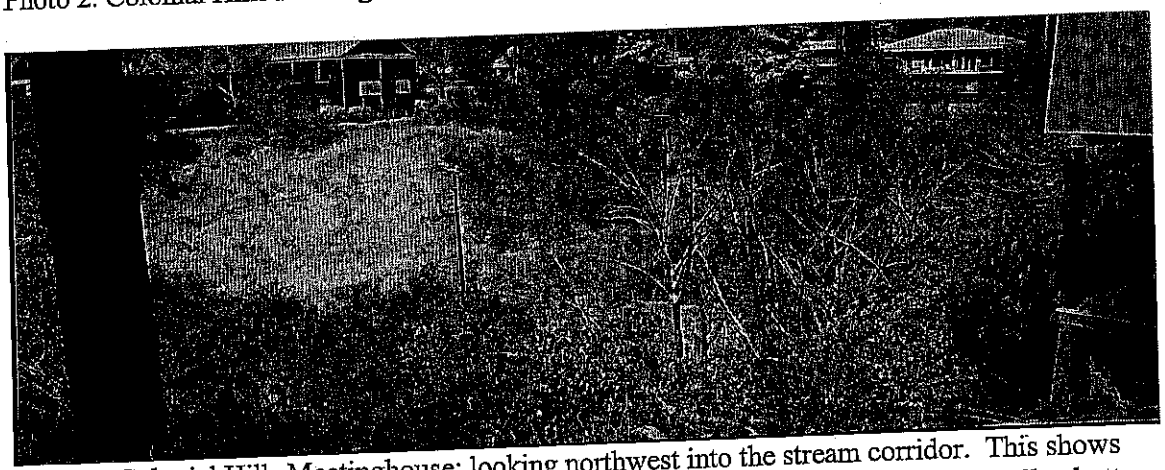


Photo 3. Colonial Hills Meetinghouse; looking northwest into the stream corridor. This shows the tall willows and cottonwoods of the riparian area, and Gambel oak stands in the valley bottom and sides. (A. Cannon)

Clayton Middle School was built adjacent to the Emigration Creek corridor just west of 1900 East. The land adjacent to the school in the stream corridor was landscaped as a grassy amphitheater with mowed lawn to Emigration Creek. A bridge of sandstone slabs was also constructed across Emigration Creek in the grassy area adjacent to Clayton Middle School.

Photo 4. Clayton Middle School looking from Emigration Creek southward. Clayton Middle School will soon be rebuilt further west, and the current location will become a soccer field. The bridge of sandstone slabs on Clayton Middle School grounds is not shown in this picture. (K. Collins)

The home currently owned by Michael Bradley (1665 E. Kensington, 84105) comprises the only housing unit existing in the Emigration Creek corridor in Wasatch Hollow. No other housing development has yet occurred in the stream corridor north of Wasatch Hollow Park due to the choices of private property owners combined with the difficulty of access and concerns about flooding. The current Bradley home was built in 1964 by Joseph Knowlton on one of three adjacent lots comprising his property in the stream corridor. Under Knowlton's stewardship, much of his property was raised and leveled by filling it with soil and other material. The origin of material for the fill is unknown, but roadway markers and concrete pieces are visible in the fill adjacent to the stream, suggesting that at least some of the material came from nearby roadwork. Altering the natural topography by filling the Knowlton property covered springs and constrained the stream channel along the property. In 1995, much of the Knowlton property (the two lots without a house) was zoned (or re-zoned) open-space by Salt Lake City (the lot where the house currently stands remained in residential zoning). However, prior to 2003 the entire property was re-zoned by Salt Lake City appropriate for residential development (zoned R-1-5000), and was removed from FEMA floodplain status (See FEMA, Letter of Map Revision and attached documents. February 10, 2005. Case No. 04-08-0707P, City of Salt Lake City, UT, Community No. 490105). Michael Bradley purchased the property in 2003.

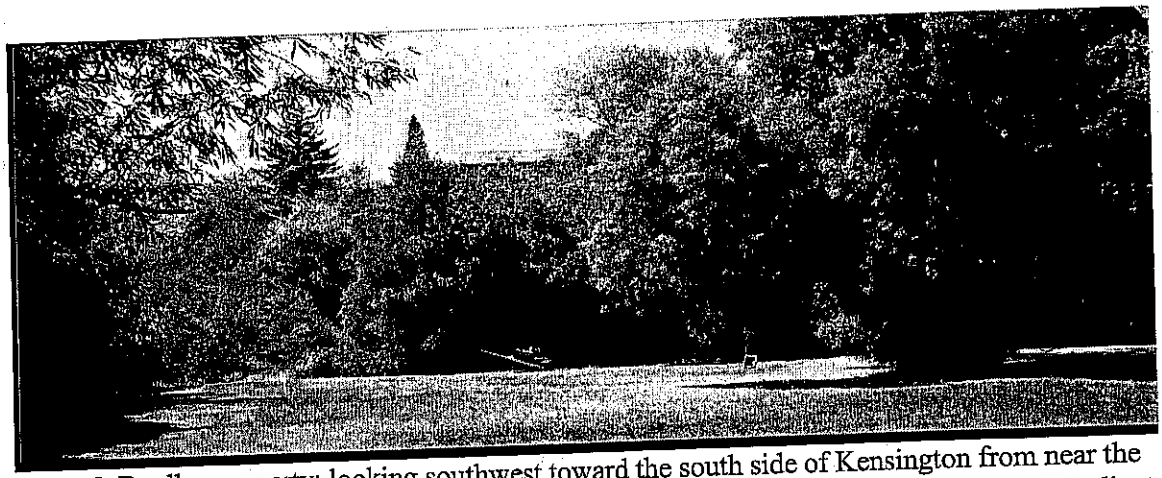


Photo 5. Bradley property; looking southwest toward the south side of Kensington from near the fence bordering Emigration Creek. The hillside in this photo is included in the proposed Madison Park Subdivision for the Bradley property. (A. Cannon)

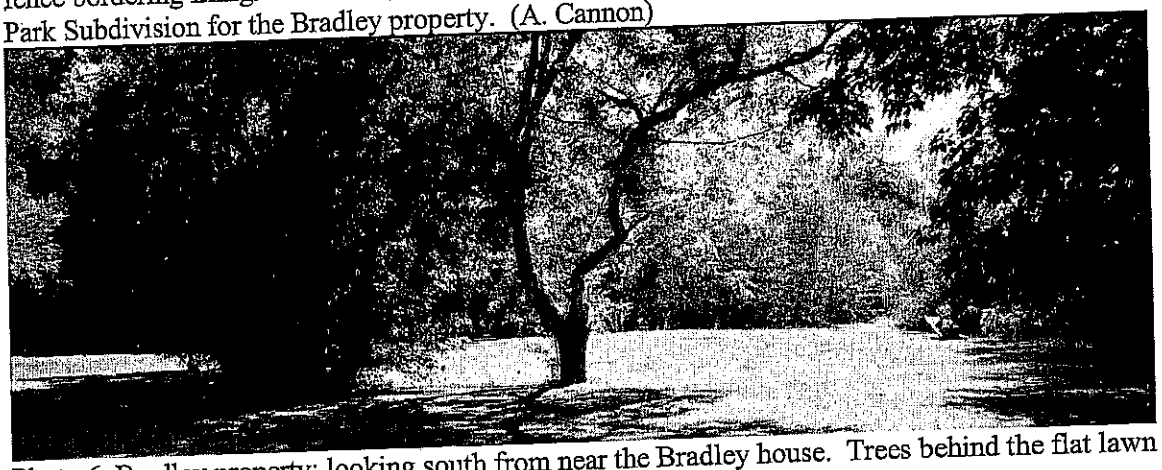


Photo 6. Bradley property; looking south from near the Bradley house. Trees behind the flat lawn border Emigration Creek. (A. Cannon)

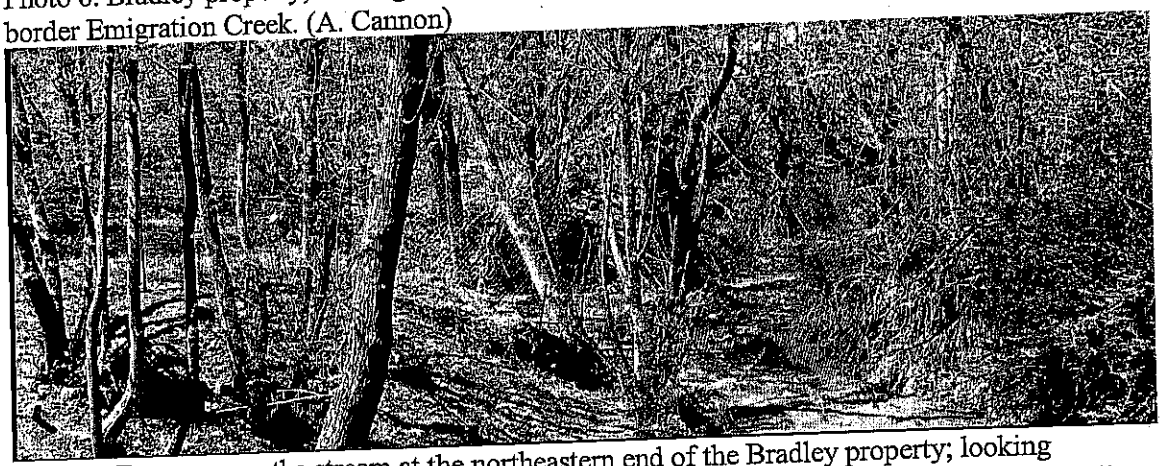


Photo 7. Fence across the stream at the northeastern end of the Bradley property; looking northwest. Land on the far side of the fence is Bradley property. The stream bend shown will erode further into the Bradley property over time unless intervention is performed. Alternatively, this is one of a few desirable natural meanders on the stream that could be encouraged. If the Bradley property is managed for natural rather than residential value, this bend would contribute to the health of corridor by helping to connect the stream and riparian habitat. Bends such as this dissipate energy from the stream, reducing the potential for downstream erosion and damage from high flows. (A. Cannon)

Wasatch Hollow Community Park

Wasatch Hollow Community Park forms the southern boundary of the undeveloped portion of the Emigration Creek corridor in Wasatch Hollow. The Park is located adjacent to the Wasatch Presbyterian Church on 1700 South and 1650 East, on land donated by the Presbyterian Church. The Park was planned to be completed in three phases, phases I and II of which have been completed. Phase III has not yet been completed as it was originally envisioned. The planned phases are:

Phase I: Completed 1993. Parking area, playground surrounded by rocks, restrooms, and drought-tolerant demonstration gardens. The demonstration gardens consist of native trees and shrubs adjacent to the grassy park area and playground. No interpretive material is available for the native plants.

Phase II: Completed 1994. Restrooms, paths, lighting, benches, and automatic irrigation.

Phase III: Not yet completed. Plans included a bridge across the stream, pathways, and overview area, a picnic area, and landscaping. Informal walking and bicycle paths exist in the area intended for Phase III of the Park. No bridge has been constructed.

Photo 8. North end of Wasatch Hollow Community Park; looking northwest. The natural area of the stream corridor is visible extending to the right of the photo. (A. Cannon)

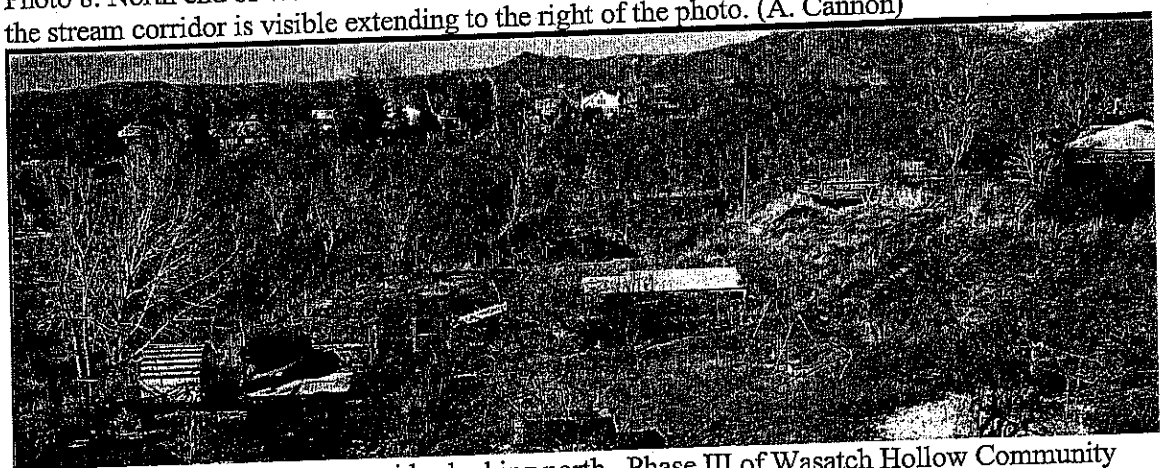


Photo 9. View of the stream corridor looking north. Phase III of Wasatch Hollow Community Park includes the dense trees around the stream through the center of this photo. (A. Cannon)

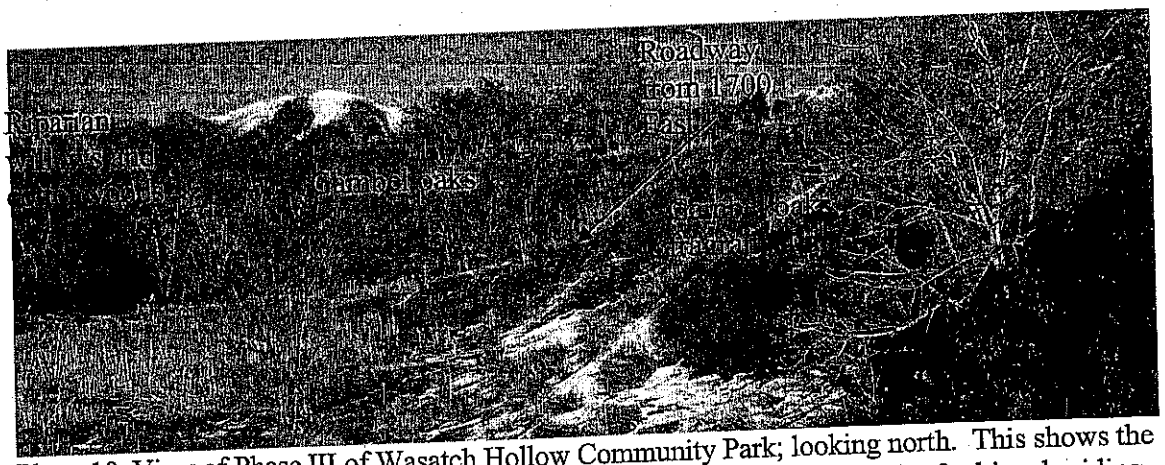


Photo 10. View of Phase III of Wasatch Hollow Community Park; looking north. This shows the roadway coming into the stream corridor from 1700 East. This area is popular for bicycle riding and sledding. For scale, notice the person just entering the riparian trees on the left (A. Cannon)

Dogs

Wasatch Hollow Community Park and the stream corridor in Wasatch Hollow are popular for use by dogs. Dog owners use Wasatch Hollow Park daily, and many travel with their dogs into the natural area of the stream corridor (Phase III of the Park and upstream). Current regulations require dogs to be leashed, but this regulation is largely ignored in Wasatch Hollow Community Park and adjacent stream corridor. Currently, off-leash dogs can be frequently encountered in the stream corridor where they run throughout the corridor and in the stream. Consequences of these off-leash practices include denudation of stream banks and prevention of the reestablishment of vegetation. Off-leash dogs disturb wildlife, possibly including low-nesting birds and fledglings. Off-leash dogs also disturb and may help curtail the activities of other nest and bird predators such as cats, rats, and raccoons. However, nuisance animals are better controlled by careful management practices than by off-leash dogs. Dog waste also continues to be a problem as some dog owners do not clean up the dog waste or dispose appropriately of plastic dog-waste baggies.

Many dog owners have expressed their enjoyment of an area where dogs can romp off-leash. Other community residents have expressed concerns about off-leash dogs, especially with regard to their interactions with children.

Roads

No public roads exist in the stream corridor. However, roadways have been cut into the valley walls in several places for vehicular access to the valley bottom:

1) Just north of the Wasatch Hollow Park pavilion to access the drains where Emigration Creek is routed under the park.
2) From the same point at Wasatch Hollow Park to the southern end of the current Bradley property.
3) From the eastern end of Kensington Drive into the current Bradley property (this is the driveway to the current Bradley residence). The driveway into the current Bradley property has been paved. No other paved roadways exist in the Wasatch Hollow stream corridor.
4) From 1700 E into the open meadow at the northeastern end of Phase III of the Wasatch Hollow Community Park, and
5) From the eastern side of the LDS Church Colonial Hills Meetinghouse parking lot eastward to the valley bottom on current LDS Church property.

Land Stewardship and Management

Land stewardship is currently the responsibility of the various landowners. Salt Lake County has stewardship of the stream and stream banks. Individual private landowners manage their lands variously. Overall the management strategy for all landowners (including Salt Lake City) is for minimal interventions of any kind. Ecological conditions are not formally managed. Some individuals have removed invasive plant species from their property, but this does not appear to be generally nor consistently occurring over much of the stream corridor. There is no formal, comprehensive strategy for management or enhancement of native plant communities or wildlife habitat. Most activities with direct influence on ecological conditions of much of the stream corridor are informal—resulting from recreational activities such as dog-walking and bicycling. Salt Lake County Engineering Division has assessed the stability of the stream (see attachment; contact Kathlyn Collins). Removal of wood and other obstructions from the stream has occurred in the past by Salt Lake County Flood Control Engineering Division. Currently, Salt Lake County Flood Control Engineering Division maintains and cleans the catchment basin drains just north of Wasatch Hollow Community Park.

Landscape Alterations

The Wasatch Hollow portion of the Emigration Creek corridor retains its overall native geomorphology as a stream valley with a moderately meandering stream and steep valley walls. Fill from residential and road development has altered the shape of the valley walls in many places. Several natural springs used to flow above ground in the Hollow, but they have now been covered by fill from adjacent homes. Fill on the current Bradley

property forms the west bank of the stream along that property. Many private landowners have fences or shrubby barriers between their property and the stream corridor. A chain-link fence surrounds the current Bradley property in the corridor. This fence transects the stream channel where a stream bend occurs on the northeastern side of the Bradley property. Several landowners on the eastern side of the stream have also erected chain-link fences in the stream corridor near the current Bradley property. One chain-link fence has been constructed perpendicular to the corridor on the border of private property (1715 E. Kensington, currently owned by Ethel Palmer) as a barrier to travel along the floodplain terrace. This fence has been vandalized in several places by cutting it to facilitate travel along the corridor. A smaller (3 ft) fence parallel to the stream at the western end of the same property is buried by silt to more than half its original height. A large chain-link fence has been erected around the Clayton Middle School property across the stream corridor. This fence is meant to be impassable, but students and other people still manage to get around, under, or over it.

Recreational use has led to limited landscape alterations: primarily informal trails in various places, bicycle trails with dirt ramps in Phase III of the Wasatch Hollow Community Park, and compaction and erosion from stream bank denudation occurring from the upstream end of the current Bradley property through the Phase III portion of the park.

Stream morphology is highly influenced by the urban surroundings and by the stream's history of having obstructions cleared. Flashy, higher flows resulting from stormwater runoff from impervious surfaces of the urban environment contribute to scouring and incision of the stream channel. The lack of obstructions such as logjams in the stream contributes to faster flows in the stream and increased incision and stream bank erosion. Lateral constraint by fill decreases the capacity of the stream for widening and so hastens vertical incision. Severe denudation of the stream banks and some riparian terraces has occurred in the southernmost portion of the Hollow as a result of unfocused use by people and dogs in combination with stream flooding. High sediment loads from disturbances such as upstream construction near the stream and by upstream erosion contribute to scouring in some places and to altered streambank morphology in depositional areas such as the downstream portions of the catchment basin.

Detention Basin

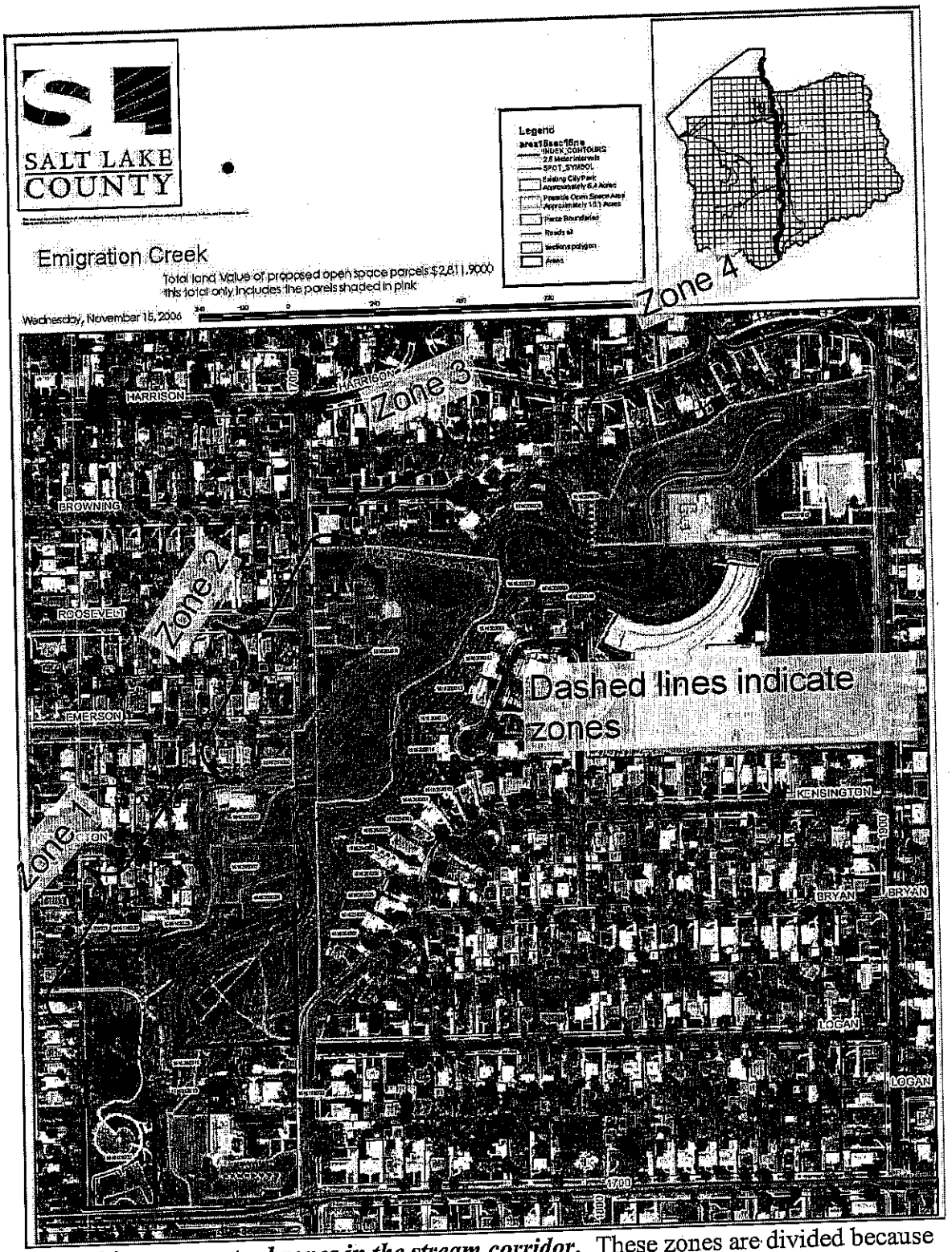
The drain system where Emigration Creek enters a culvert under Wasatch Hollow Community Park incorporates three grated drains arranged vertically ("debris tower") along the downstream embankment ("dam") of the catchment area. These drains are designed to flood a portion of the stream corridor if any of the drains become blocked, with the intent that all three drains will not become blocked as water levels rise and flows change. The detention basin planned for maximum flood extends upstream to a level about halfway through the LDS Church property by the Colonial Hills meeting house, and includes Phase III of the park. If flooded to the top drain, maximum water depth in the detention basin would be several meters.

Photo 11. Stacked drains in the embankment at the southern end of the detention basin. Emigration Creek flows into the lowest drain in this picture. (A. Cannon)

Zones

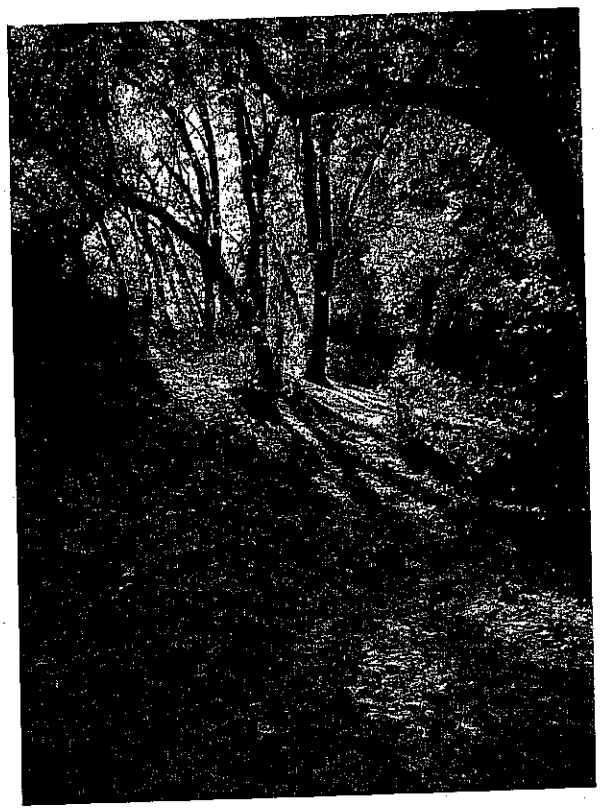
Overview

The stream corridor in Wasatch Hollow is valuable because of its size, and must be considered as an ecological entity. For the sake of ecological integrity and the benefits of natural, biologically diverse areas, every effort should be made to preserve the entire corridor in Wasatch Hollow. Management should consider the entire stream corridor upstream from and in Wasatch Hollow and consequences of stream and land management downstream from Wasatch Hollow. Although some ecological preservation and restoration projects will be constrained to limited portions of the stream corridor, interventions should occur with consideration for plant and animal communities of the entire corridor. However, the stream corridor has not received homogeneous impacts. Clear needs for ecological preservation and restoration differ along the length of the corridor. The corridor may be conceptually divided laterally into four zones. Designation of these four zones is based on human impact, ownership, ecological conditions, and expressed desires of Wasatch Hollow Community members. The four conceptual zones do not imply that the corridor may be divided into four independent zones for housing or commercial development, but rather that preservation and restoration may be tailored to four different zones to benefit the ecosystems of the entire corridor. As preservation and restoration progress, the extent and needs of these zones should be monitored and re-evaluated.



Map of four conceptual zones in the stream corridor. These zones are divided because of differing ecological condition, ownership, and expressed desires of Wasatch Hollow Community members. Zones represent only conceptual delineations for restoration purposes.

Zone 1



Zone 1 is the furthest downstream portion of the Wasatch Hollow stream corridor. Zone 1 begins at the embankment where Emigration Creek is routed under Wasatch Hollow Park, and continues upstream to approximately the upstream end of the current Bradley property (at the edge of the 1700 East right-of-way).

Photo 12. View from the informal trail along the east side of the stream looking southward. The open sky visible at the top left of the picture is the open area of Phase III of Wasatch Hollow Community Park. The person just entering the riparian area in Photo 10 above was on this trail by the tree with the large dark trunk in the center of this picture (A. Cannon)

Positive, Zone 1

- Zone 1 has the same general positive ecological conditions as the rest of the stream corridor, including the following:
    - The stream channel currently includes meander bends even though somewhat constrained.
    - There is enough space in the corridor to rehabilitate the stream channel, riparian habitat, and other habitat further if the current Bradley property is included.
    - There is enough space and micro-climatic variety to foster a healthy mosaic of habitat types in Zone 1, particularly if the current Bradley property is included.
- Students from Westminster College under the direction of Ty Harrison planted some native shrubs on the terrace and stream valley walls east of the stream just north of Wasatch Hollow Park.
- Human access to the natural area in the stream corridor is easy from Wasatch Hollow Park.
- If the Bradley property is purchased, the landscape favors a nested-trail loop that will constrain public use in portion of Zone 1. This trail should be of natural material and unobtrusive to preserve the natural area. A trail is needed in Zone 1 to focus human activity away from sensitive, denuded areas, to prevent further denudation, and to allow restoration of plants to

the riparian area and nearby land. A loop trail will encourage people not to venture further upstream in the corridor, as well as encouraging people not to explore onto private land to the east, and allow improved monitoring and law enforcement.

Negative, Zone 1

- Zone 1 is the most ecologically degraded area in the stream corridor.
- The stream channel is incised as a result of artificially confining the stream with property fill on the western side (the Bradley property) and by the removal of logs and other natural flow modifiers.
- Stream connectivity with the riparian area is impaired because the stream is incised and artificially constrained.
- Stream banks have been denuded largely as a result of use by people and dogs.
- Reestablishment of ground cover plants on stream banks appears to be prevented by disturbance from people and dogs in combination with scouring from high flows.
- Valley landforms away from the stream have been highly altered by residential fill and adjacent road construction.
- Undesirable, invasive plants are common.
- Currently humans and dogs move wherever they want to across the landscape. Without guidance of appropriate trails and vegetation, this movement will continue to contribute to stream bank and corridor degradation.
- Some chain-link fences are in the corridor and most are in disrepair.
- Minor, relatively simple graffiti has been painted on some trees, rocks, and other structures.

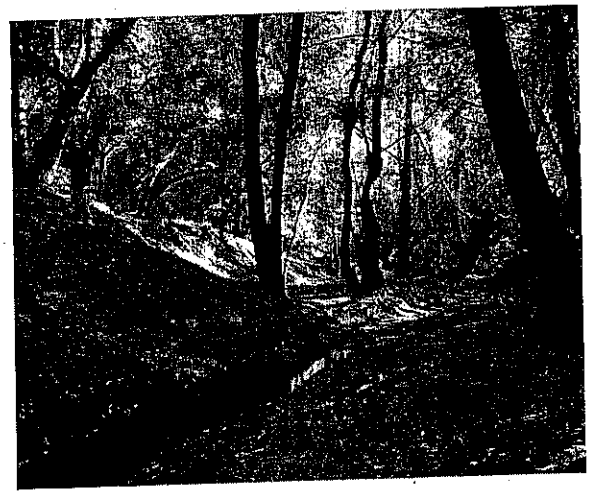


Photo 14. Community clean-up volunteers in Zone 1. View is looking northward along the informal streambank trail onto private property adjacent to the stream to the east. (A. Cannon)

Photo 13. Looking southward from right by the fence across the stream on the Bradley property. The Bradley property is to the right in this photo. This photo shows denudation typical of Zone 1. Boy is on rope swing. (K. Collins)

Zone 2

Zone 2 begins in the corridor approximately even with the upstream end of the current Bradley property and continues through to approximately the level of the upstream end of the current LDS church property.

Photo 15. This view is from LDS Church property looking north. Dense native Gambel oak stands can be seen to the right and center in this picture. The Colonial Hills Meetinghouse is out of the picture at the top of the hill to the left. Yellow cottonwoods are visible in the riparian area near the center of the picture. (A. Cannon)

Positive, Zone 2

- Zone 2 has the positive ecological elements of Zone 1, but is in better ecological condition than Zone 1.
- Stream banks are more vegetated (less denuded) than in Zone 1.
- The stream channel is less incised than in Zone 1.
- Attractive native Gambel oak stands occur in the corridor in the upstream portion of Zone 2.
- Limitations on human access to Zone 2 are favored by steep corridor walls.

Negative, Zone 2

- Invasive plants are present.
- Stormwater runoff from 1700 East is diverted directly into the stream corridor, forming a small erosion gully on the west side of the corridor.
- Asphalt and concrete road debris has been dumped into the sides of the corridor from 1700 East and in other locations.
- Unrestricted paint ball and air soft shooting games occur, primarily on LDS church property west of the creek. These shooting games result in the presence of large numbers of plastic bb's, paint on trees and other landscape elements, and unrestricted human movement on the landscape.

- Anti-social activity occurs primarily in hide-outs under the riparian canopy close to the stream.
- People have built unstable wood and rock dams in locations where they may contribute to inappropriate stream bank erosion.

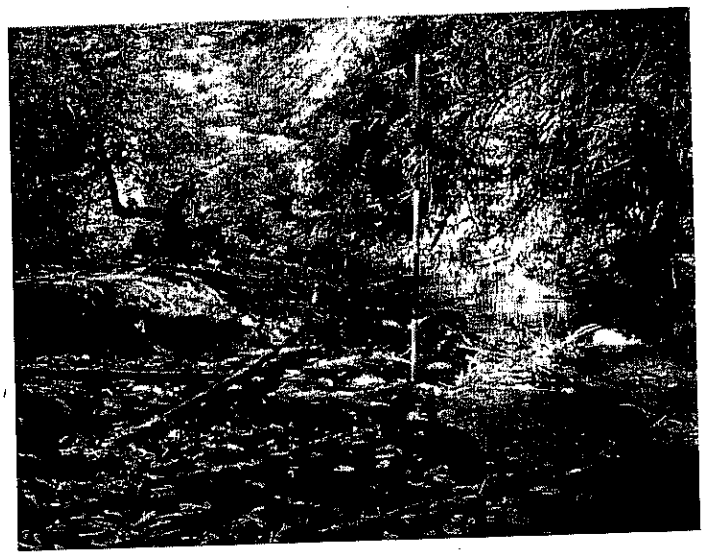
Photo 16. This view from within the 1700 right-of-way looking north into Zone 2 shows the dense trees and vegetation of this area interspersed with open areas. Taller trees are in the riparian area out of this picture to the right, but Zone 2 is especially notable for its beautiful upland shrub mosaic. (A. Cannon)

Photo 17. Community stream corridor clean-up volunteers. View is looking north into Zone 2. (D. Jensen)

Photo 18. A hideout on LDS Church property near Emigration Creek, just west of the Colonial Hills Meetinghouse. (A. Cannon)

Photo 19. View of Emigration Creek looking downstream from the hideout in the picture to the left. (A. Cannon)

Zone 3



Zone 3 consists of currently private property between the LDS church property and the Clayton Middle School grounds. These 6 parcels of private property span the entire stream corridor just west of where 1800 East would transect the corridor.

Photo 20. View typical of stream channel in Zone 3. (K. Collins)

Note: My assessment is limited to the stream channel and immediately adjacent riparian area in Zone 3 because I have only walked along the stream in Zone 3. I have not visited private property in Zone 3 away from the stream.

Positive, Zone 3

- The stream channel is less incised than in other zones, has good structure such as undercut banks and pools, and is well-armored in many places by willow roots.
- The riparian habitat is relatively well-developed and stream banks are well-vegetated.

Negative, Zone 3

- Invasive plants are present.
- Anti-social and undesired human activity occurs in the riparian area.

Photo 21. Willow roots (red) like these hold the banks stable in Zone 3. These roots are found in all Zones, but are very well developed in Zones 2, 3, and 4. The root-protected banks are stable and provide shelter for organisms in the stream. (K. Collins)

Zone 4

Zone 4 consists of the portion of the stream corridor from the upstream boundary of Zone 3 to 1900 East. Most of Zone 4 is currently on Clayton Middle School grounds or owned by Rocky Mountain Power.

Photo 22. View looking westward onto the Clayton Middle School grounds. (K. Collins)

Positive, Zone 4

- Ecological conditions are similar to those in Zone 2.

Negative, Zone 4

- Invasive plants are present.
- This area receives litter from on-site and adjacent human use.

Photo 23. Emigration Creek emerging from the culvert under 1900 East into Wasatch Hollow. (K. Collins)

VEGETATION AND SOILS

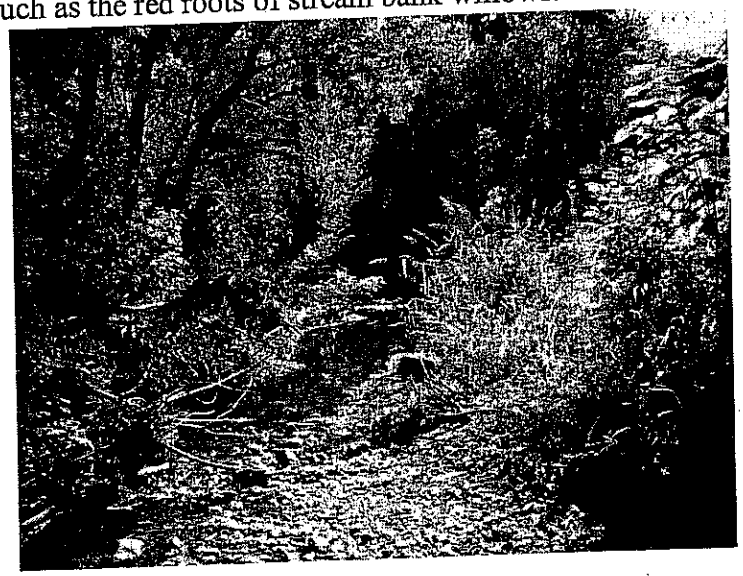
Soils

Soils in the Emigration Creek corridor in Wasatch Hollow are mollisols with mixtures of fill soils from a variety of sources. Streambank sediment is silty in the catchment basin. Clay deposits are reported to exist in the northern and southern portions of the corridor in Wasatch Hollow.

Habitat Types

Stream

Emigration Creek in Wasatch Hollow is a beautiful, clear, small stream that provides water resources for riparian soils, plants, wildlife, and people. Riparian soils and plants depend on the stream water. The structure of riparian communities depends both on the presence of the stream and on its dynamics. For example, the frequency and extent of floods help to determine plant community composition in part by helping to control ecological succession of streambank communities. Stream and riparian plant interactions help to shape the stream form. Currently the stream banks are held in place in many instances by the roots of riparian plants such as the red roots of stream bank willows. Terrestrial wildlife uses the stream, and aquatic organisms contribute to a dynamic stream ecosystem. The stream helps to cool and moisten the air in the summer. People can enjoy the sounds, sights, and smells of the stream in all seasons of the year. For instance, a photographer was observed capturing images of winter ice along the stream.



Photos 24 & 25. Emigration Creek in Wasatch Hollow. K. Collins

Utah Division of Wildlife Resources lists flowing water habitat as very rare and declining (less abundant and less healthy than previously) in Utah. Currently they report flowing water habitat as comprising less than 0.1% of Utah's land area. Flowing water habitat, such as Emigration Creek in Wasatch Hollow, is therefore a high priority for preservation in Utah.

Emigration Creek emerges into Wasatch Hollow from a culvert under 1900 East and re-enters a culvert at the embankment just north of the grassy area of the Wasatch Hollow Community Park. Although Emigration Creek rarely dries completely in Wasatch Hollow, summer flows are often very low in late summer and mid-winter. High flows occur primarily with snowmelt in the spring, peaking generally in April or May, although peak flow timing varies. The stream water is generally clear, but elevated flows bring quite a bit of sediment. A single flood event in October 2006 was observed to deposit as much as 1 cm of sediment on streambanks in the downstream portion of Wasatch Hollow by the Park.

The stream is in better ecological condition further upstream in Wasatch Hollow. In Zones 2-4 the stream banks and bed appear fairly stable, the stream is not as incised, and the channel cross-sectional shape is rounder, often with channel structure providing overhead cover in the stream against the banks. In Zone 1, the stream banks and bed appear generally unstable, the stream is deeply incised, and the channel cross-sectional shape is typically V-like, usually with little cover against the banks. These differences led the Salt Lake County stream surveyors in 2005 to split the stream in Wasatch Hollow into two reaches: Reach 7A corresponds with Zones 2, 3, and 4, and Reach 7B corresponds with Zone 1 in this baseline document (see attached Salt Lake County Engineering Division, Level III Channel Stability Study. 2005. K. Collins).

Emigration Creek Physical Characteristics in Wasatch Hollow
*Note: *indicates data provided by Salt Lake County Engineering Division, Level III Channel Stability Study. 2005. K. Collins.*

- Bankfull Channel Width: approximately 4-6 m
- Bankfull Channel Depth: approximately 0.5-1 m
- Width to Depth Ratio*: generally about 6
- Gradient*: approximately 3%
- Sinuosity*: approximately 1.2
- Channel Bedding: generally competent composite of sediment, gravel, and cobbles, rarely boulders.
- Channel Type: Pool-riffle; pool habitat is lacking, probably due to historical removal of flow obstructions.
- Large Wood Structure: rare and tending to small, unstable jams.

- Flows: at nearest stream gage, which is upstream from Wasatch Hollow at the mouth of Emigration Canyon

	Flow (cubic feet/second)	Time of Year
Lowest Flow 2000-2004	0.12 (SD=0.28)	late summer, mid-winter
Highest Flow 2000-2004	20.16 (SD=9.95)	April or May
Mean Flow 2000-2004	3.29 (SD=1.44)	(summary year round)
Estimated Flood Flow	120	na
Record Flood of 1983	146	May

Data from Salt Lake County Flood Control Engineering Division
http://www.pweng.slco.org/flood/streamFlow/history/index80.cfm
Minimum, Maximum, and Mean flows from water years 2000-2004
SD = standard deviation

- Rosgen Classification*: closest to B-4
- Pfankuch Stability Ratings*:
(Higher ratings indicate more unstable stream; Zone 1 was rated as the least stable stream reach along the entire length of Emigration Creek.)

	Upper Bank	Lower Bank	Stream Bed	Total
Zones 2,3,4 *(SL County Reach 7A)*	29	40	43	112
Zone 1 *(SL County Reach 7B)*	36	46	52	134

- Bridges: 1) sandstone slabs across the stream on Clayton Middle School grounds.
- Dams: 1) Cement overflow structure in the stream on Clayton Middle School grounds.
  2) Embankment at furthest downstream location of above-ground flow of Emigration Creek in Wasatch Hollow. (See "Detention Basin" above.)
- Chemical:
  - No chemical data were collected in Wasatch Hollow during baseline assessment to date.
  - Paucity and type of stream invertebrates suggests low water quality (see Stream Invertebrates below).
  - Nearest available data are 6 measurements during October and November 2006 in Emigration Creek on Westminster College Campus:
    Dissolved Oxygen: 10.00-10.20 mg/l
    Nitrates: 0.6-1.7 mg/l
    pH: 7.3-7.9
    -Data collected by Kevin Whipple;
    http://people.westminstercollege.edu/faculty/tharrison/emigration/chemical.htm

Lowland Riparian

The lowland riparian habitat along Emigration Creek in Wasatch Hollow includes large trees, dense shrubs particularly in upstream areas, and a variety of forbs and grasses. The largest trees exceed 40 cm diameter at breast height and 30 m in height. These large trees and other riparian plants help to stabilize stream banks, prevent erosion, moderate the environment adjacent to the stream, and provide extremely valuable wildlife habitat. Riparian habitat is the most important habitat for birds in this area. Most birds in the great basin are dependent on or use riparian habitat (Gardner, Stevens, & Howe. 1999. UDWR Pub. No. 99-38). For instance, riparian habitat provides valuable nesting and foraging habitat for neotropical migrants such as warblers. Other wildlife including invertebrates heavily use riparian habitats. Riparian habitat is typically the most biologically diverse habitat in western US landscapes (Kelsey & West. 2001. Ch 10 in Naiman & Bilby *eds*. River Ecology and Management. Springer Verlag. NY).

Photo 26. View of the stream and lush riparian habitat. K. Collins

Utah Division of Wildlife Resources assesses lowland riparian habitat currently at about 0.2% of Utah's land area, and report that it is very rare and declining. It is estimated that over 90% of riparian habitat in Utah has been lost or negatively altered (Gardner, Stevens, & Howe. 1999. UDWR Pub. No. 99-38). Lowland riparian habitat such as that in Wasatch Hollow is therefore a high priority for preservation and ecological restoration in Utah.

Human use of the riparian habitat is high in Wasatch Hollow, as this habitat provides many of the natural characteristics that are appealing to people, such as green vegetation, access to water, and birds. The consequences of human use of the riparian habitat in Wasatch Hollow include denudation of stream banks in Zone 1, and loss of or damage to riparian plants in many areas. In addition, riparian plant communities do not currently reflect ideal connectivity with the stream (e.g., stream-caused disturbance of streambanks) because of the urban context, particularly because the stream has become increasingly incised and flow obstructions have been removed. Illegal or anti-social activities such as drug use occur in many areas of the riparian habitat, probably because the stream and dense riparian vegetation provide secrecy. For example, drug use paraphernalia was found hidden under wood in an obviously well-used low area in the midst of riparian vegetation near the stream just east of the Colonial Hills LDS Church meeting house. Birds and other vectors have also contributed to the spread of undesirable invasive plants into the riparian area in Wasatch Hollow.

Photo 27. Emigration Creek and riparian habitat showing dense vegetation growing near the stream in many areas. Notice the leaves in the stream, which provide carbon for stream-dwelling organisms. (A. Cannon)

Native Riparian Shrubs and Trees

Characteristic native shrubs and trees in the lowland riparian habitat in Wasatch Hollow are:

Peach-leaf willow *Salix amygdaloides*

Coyote willow *Salix exigua*

Narrow leaf cottonwood *Populus angustifolia*

Fremont cottonwood *Populus fremontii*

Box elder *Acer negundo*

Photo 28. Box elders, messy in yards and harborers of bugs, are at home and valuable in natural riparian habitat in Wasatch Hollow. These native Utah trees provide shelter and nesting habitat for wildlife and host native insects that feed other native animals. (A. Cannon)

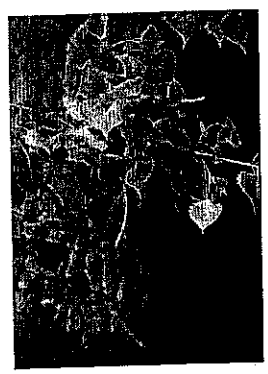


Photo 29. Cottonwoods, still abundant in Wasatch Hollow, are the hallmark riparian tree in this area of Utah, but have been lost at alarming rates as riparian habitats have been altered through human activities such as urban development. Native cottonwoods provided material for shelter, fire, clothing, and even food for early people in the Salt Lake Valley. These trees are excellent sources of shelter and food for riparian wildlife. Cottonwood trunks and branches often become homes for cavity nesting birds and animals such as northern flickers found in Wasatch Hollow.
(A. Cannon)

Mountain Shrub

Mountain shrub habitat occurs in the upland transitional fringe areas of the Emigration Creek Corridor in Wasatch Hollow. Mountain shrub habitat in Wasatch Hollow is marked by Gambel oak and shrubs that grow best in relatively dry conditions. Gambel oak and shrub stands provide biodiversity, valuable edge habitats, and visual diversity in Wasatch Hollow. Mountain shrub habitat includes native plant species and communities that are hard to find in an urban setting. Native Americans and early emigrants used shrubs and plants of the mountain shrub habitat for food and other purposes. Currently, mountain shrub habitat provides a variety of animal foods and supports wildlife through all seasons.

Photo 30. Fragrant sumac, abundant in the mountain shrub habitat in Wasatch Hollow, was valued by Native Americans for the fruit, twigs, leaves, and shoots. The fruits were used for food and medicine and to make a drink like lemonade. The young stems were made into baskets. Fragrant sumac was used to make dyes for clothing. Early pioneers ate the salted fruits and chewed stem exudates like chewing gum. The shrub and its fruits provide shelter and food for birds and other animals throughout the year. (G. Cotter)

Utah Division of Wildlife Resources reports that mountain shrub habitat comprises less than 2% of Utah's land area, is stressed by human impacts, and is probably declining. Although mountain shrub habitat currently occurs along the Wasatch Front, it is very rare in urban settings, and is being replaced in many areas by subdivisions and housing development. Mountain shrub habitat, such as that in Wasatch Hollow, is therefore also a high priority for preservation and ecological restoration in Utah.

Photo 31. Young students pointing to something they have spotted in the mountain shrub habitat in Wasatch Hollow. In this area (the southeastern end of Phase III of Wasatch Hollow Community Park), mountain shrub habitat was partially restored through planting of native species by Ty Harrison and students from Westminster College. (D. Fosnocht)

Mountain shrub habitat in Wasatch Hollow has been ecologically degraded primarily by invading non-native plants and by fill and disturbance from adjacent housing and road development. All mountain shrub habitat observed in Wasatch Hollow included invasive plant species such as Siberian elm, non-native thistles, and dalmation toadflax. Human

use of mountain shrub habitat in Wasatch Hollow includes bicycling along informal dirt tracks in Phase III of Wasatch Hollow Community Park, paintball and airsoft shooting games on LDS Church property, and travel through the corridor along informal paths by Clayton Middle School. Conditions of the mountain shrub habitat on private land between LDS Church property and Clayton Middle School were not observed during this initial assessment due to restricted access.

Native Mountain Shrubs and Trees

Characteristic native shrubs and trees of mountain shrub habitat in Wasatch Hollow are:
Gambel oak *Quercus gambelii*
Birchleaf mountain mahogany *Cercocarpus montanus*
Fragrant sumac *Rhus trilobata*
Chokecherry *Prunus virginiana* var. *melanocarpa*
Utah Serviceberry *Amelanchier utahensis*
Elderberry *Sambucus caerula*
Rabbitbrush *Chrysathamnus nauseosus*
Big sagebrush *Artemisia tridentata*
Wood's rose *Rosa woodsii*
Creeping Oregon grape *Berberis repens*

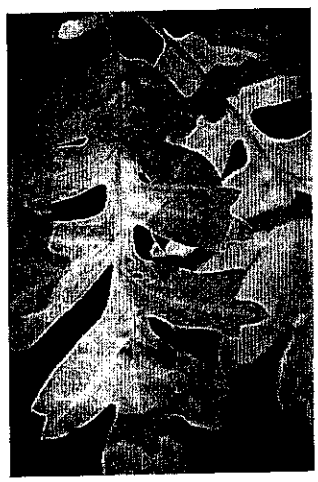


Photo 32. Gambel oak is a native tree typical of mountain shrub habitat in this area of Utah, and is abundant in beautiful stands remaining from pre-pioneer times in Wasatch Hollow. Gambel oak acorns have been valued for food, and the wood has been used for fire, fence posts, and shelter. Gambel oak acorns are valuable food for wildlife while the trees make excellent shelter for birds and other wildlife.
(G. Cotter)

Native Plants in Wasatch Hollow
Native plants observed in the stream corridor in Wasatch Hollow include (note: these plants were observed during baseline documentation visits):

Peach-leaf willow *Salix amygdaloides*
Coyote willow *Salix exigua*
Narrow leaf cottonwood *Populus angustifolia*
Fremont cottonwood *Populus fremontii*
Box elder *Acer negundo*
Gambel oak *Quercus gambelii*
Birchleaf mountain mahogany *Cercocarpus montanus*
Fragrant sumac *Rhus trilobata*
Chokecherry *Prunus virginiana* var. *melanocarpa*
Utah Serviceberry *Amelanchier utahensis*
Elderberry *Sambucus caerula*
Rabbitbrush *Chrysathamnus nauseosus*
Big sagebrush *Artemisia tridentata*
Wood's rose *Rosa woodsii*
Creeping Oregon grape *Berberis repens*
Aster *Aster* spp.
Western ragweed *Ambrosia psilostachya*
Poison ivy *Toxicodendron radicans*
Curlycup gumweed *Grindelia squarrosa*
Basin wildrye *Leymus cinereus*
Violet *Viola* spp.
Red osier dogwood *Cornus sanguinea*

Non-Native Plants in Wasatch Hollow
Invasive plants occur throughout the stream corridor in Wasatch Hollow. The harmful ecological effects of invasive plants include crowding of and competition for resources with native plants. Invasive plants tend to decrease biodiversity. Several of the most worrisome invasive plants in Wasatch Hollow and their consequences were discussed in a workshop held December 6 for the Wasatch Hollow Community (see attached Invasive Plant Information Sheet).

Invasive and non-native plants observed in Wasatch Hollow include (note: these plants were observed during baseline documentation visits):

Siberian elm *Ulmus pumila*
Russian olive *Elaeagnus angustifolia*
Green ash *Fraxinus pennsylvanica*
White mulberry *Morus alba*
English hawthorne *Crataegus laevigata*
Common apple *Malus* spp.
Sweet cherry *Prunus avium*

Plum *Prunus* spp.
Mahaleb cherry *Prunus mahaleb*
Tree of heaven *Ailanthus altissima*
Black locust *Robinia pseudoacadia*
Honey locust *Gleditsia triacanthos*
Pyracantha *Pyracantha* spp.
Tartarian honeysuckle *Lonicera tatarica*
Norway maple *Acer platanoides*
English walnut *Juglans regia*
Horse chestnut *Aesculus hipposcastanum*
Crack willow *Salix fragilis*
Greater periwinkle *Vinca major*
Lesser periwinkle *Vinca minor*
English ivy *Hedera helix*
Virginia creeper *Parthenocissus quinquefolia*
Matrimony vine *Lycium barbarum*
Bittersweet *Solanum dulcamara*
Alfalfa *Medicago sativa*
Sweet clover *Melilotus officinalis*
Chicory *Cichorium intybus*
Dandelion *Taraxacum officinale*
Kentucky bluegrass *Poa pratensis*
Crested wheatgrass *Agropyron cristatum*
Money plant *Lunaria annua*
Cheatgrass *Bromus tectorum*
Dalmation toadflax *Linaria dalmatica*
Field bindweed *Convulvus arvensis*
Prickly lettuce *Lactuca serriola*
Scotch thistle *Onopardum acanthium*
Burdock *Arctium lappa*
Snowberry *Symphoricarpos* spp.
Quack grass *Agropyron repens*

Wildlife

Many species of wildlife were observed to occur in Wasatch Hollow. Other wildlife (e.g., coyote, bobcat, beaver, and porcupine) were sighted earlier by community members, but as recent sign was not seen during baseline documentation visits, they were not included on the list. Birds on the list were either seen during baseline documentation visits or were reliably reported by Wasatch Hollow community members. Wildlife sighted in the stream corridor in Wasatch Hollow includes:

Mammals
Red squirrel *Sciurus vulgaris*
Mule deer *Odocoileus hemionus*

Raccoon *Procyon lotor*
Norway rat *Rattus norvegicus*
House mouse *Mus musculus*
Bat (probably *Myotis* spp.)

Birds
Red-tailed hawk *Buteo jamaicensis*
Rough-legged hawk *Buteo lagopus*
Cooper's hawk *Accipiter cooperii*
Sharp-shinned hawk *Accipiter striatus*
American kestrel *Falco sparverius*
Turkey vulture *Cathartes aura*
Western screech owl *Otus kennicottii*
Great horned owl *Bubo virginianus*
Mallard *Anas platyrhynchos*
Canada goose *Branta canadensis*
California gull *Larus californicus*
Western scrub jay *Aphelocoma californica*
Ruby-crowned kinglet *Regulus calendula*
Yellow warbler *Dendroica petechia*
Downy woodpecker *Picoides pubescens*
Hairy woodpecker *Picoides villosus*
Northern flicker *Colaptes auratus*
Red-breasted nuthatch *Sitta canadensis*
White-breasted nuthatch *Sitta carolinensis*
House finch *Carpodacus mexicanus*
American goldfinch *Carduelis tristis*
Black-headed grosbeak *Pheucticus ludovicianus*
Evening grosbeak *Coccothraustes vespertinus*
Pine siskin *Carduelis pinus*
White-crowned sparrow *Zonotrichia leucophrys*
House sparrow *Passer domesticus*
European starling *Sturnus vulgaris*
American robin *Turdus migratorius*
Thrush (probably *Catharus ustulatus*)
Oregon junco *Junco hyemalis*
Black-billed magpie *Pica hudsonia*
Cedar waxwing *Bombycilla cedrorum*
Mourning dove *Zenaida macroura*
California quail *Callipepla squamata*
Black-capped chickadee *Poecile atricapillus*
Broad-tailed hummingbird *Selasphorus platycercus*
Black-chinned hummingbird *Archilochus alexandri*
Rufous hummingbird *Selasphorus rufus*

Reptiles
Garter snake *Thamnophis* spp.

Fish
Rainbow trout *Oncorhynchus mykiss*

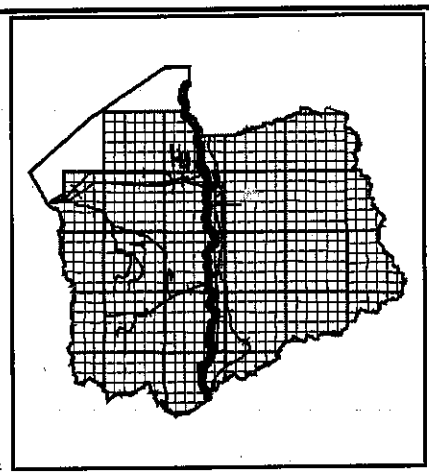
Stream Invertebrates
Mayfly larvae (probably *Baetis* spp.)
Leech (probably *Glossiphoniidae complanata*)
Snail (probably *Pyrgulopsis* spp.)
Caddisfly larvae (unknown spp.)

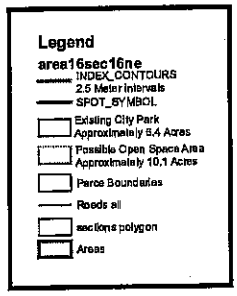
SALT LAKE COUNTY

Emigration Creek

Total land Value of proposed open space parcels $2,811,9000
this total only includes the parels shaded in pink

Wednesday, November 15, 2006





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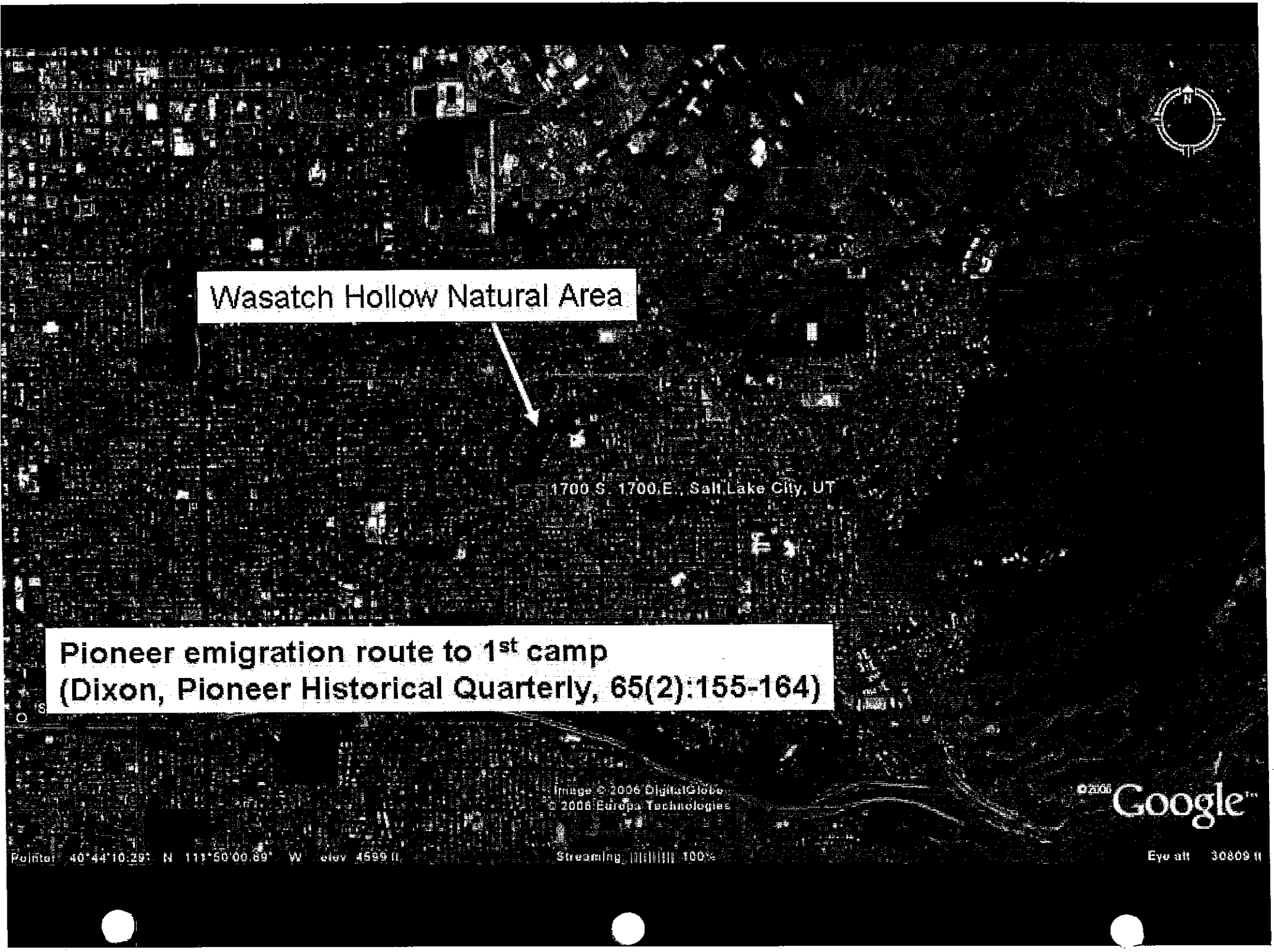
Wasatch Hollow Natural Area
1700 S, 1700 E, Salt Lake City, UT
Pioneer emigration route to 1st camp
(Dixon, Pioneer Historical Quarterly, 65(2):155-164)
Image © 2006 DigitalGlobe
© 2006 Europa Technologies
Google
Pointer 40°44'10.29" N 111°50'00.69" W elev 4599 ft
Streaming 100%
Eye alt 30809 ft