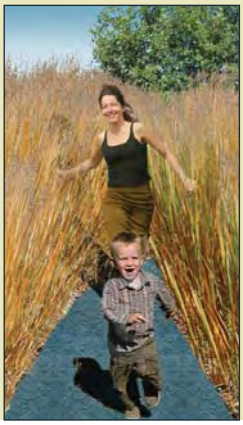
VILLAGE GREENS NORTH MASTER PLAN

CITY OF GREENWOOD VILLAGE







PREPARED BY:

ARCHITERRA GROUP

MAY 2011

Adopted by the Greenwood Village City Council on

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Mayor
Ron Rakowsky

_____

City Clerk and Recorder
Susan Phillips

ACKNOWLEDGEMENTS

The Village Greens North Master Plan is the culmination of a nearly two year long planning process. The plan is a collaborative effort between Greenwood Village Staff, City Council members, the Parks, Trails, and Recreation Commission, the U.S. Army Corps of Engineers, the consultant team, and Village residents. The individuals listed below contributed substantially by sharing their time, skills, knowledge, and thoughtful participation. In addition, numerous Village residents shared their knowledge and offered constructive comments during public meetings.

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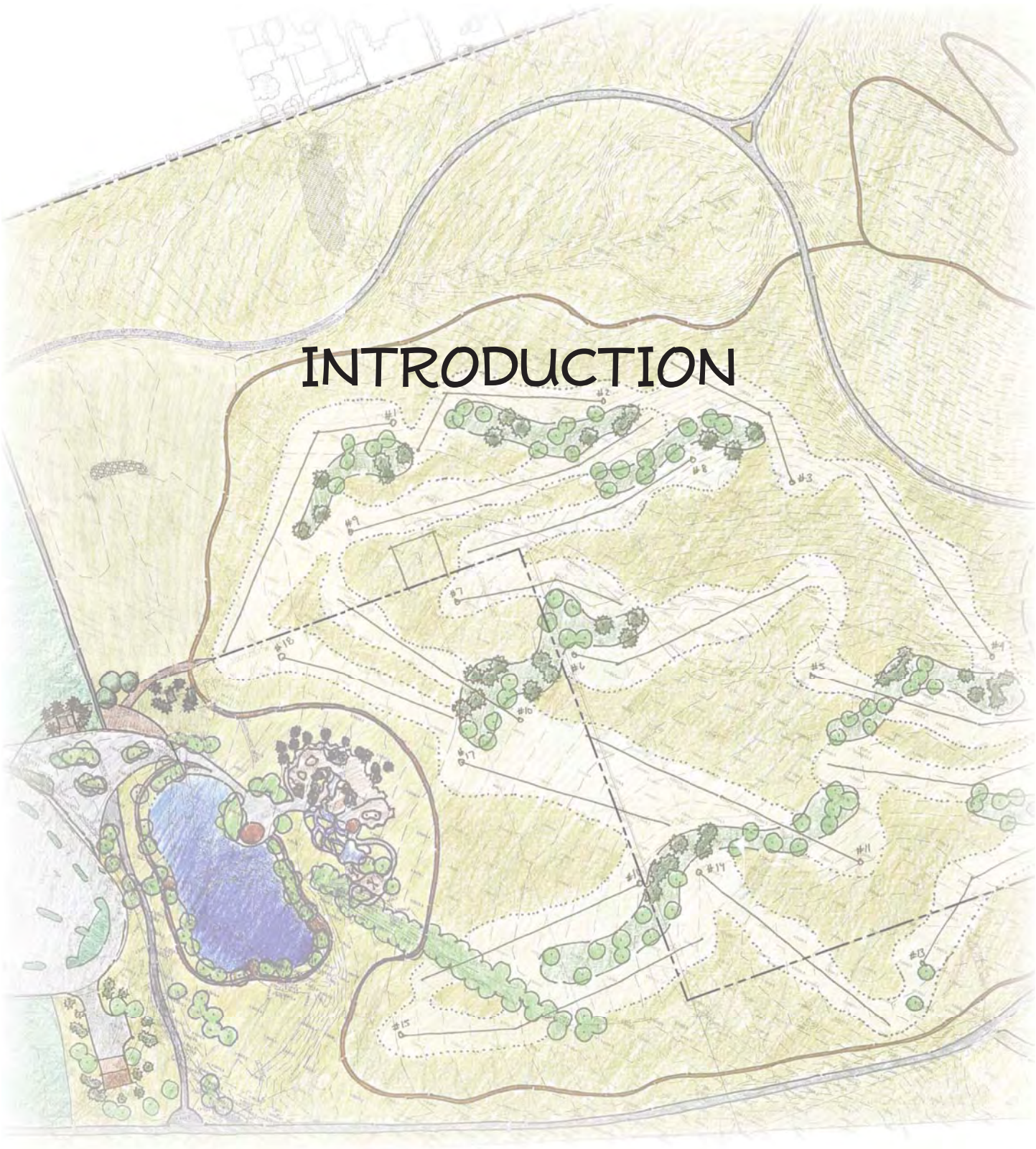
Existing Irrigation System Assessment and Pond Sizing/Draw Down Analysis
Irrigation System Gallon Per Minute Demand Calculation Sheet
Irrigation System Annual Water Consumption/Water Budget Projection

INTRODUCTION



INTRODUCTION

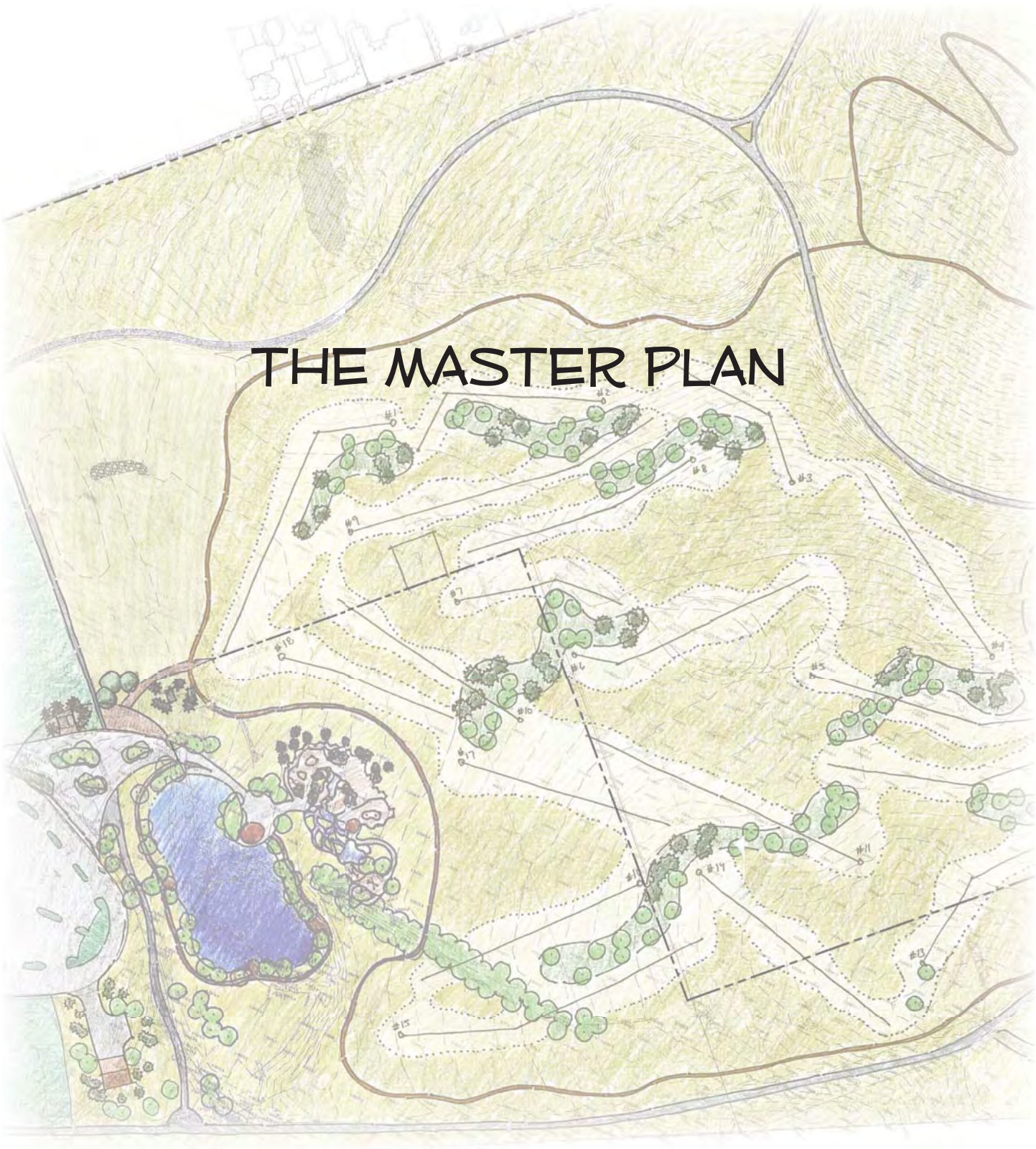
Purpose and Goals of the Plan
The purpose of the Village Greens North Master Plan is to develop a vision for a park that will serve Village residents with unique recreation amenities for many years. This master plan will serve as a guide for the future detailed design that will be required to implement the recommended improvements.

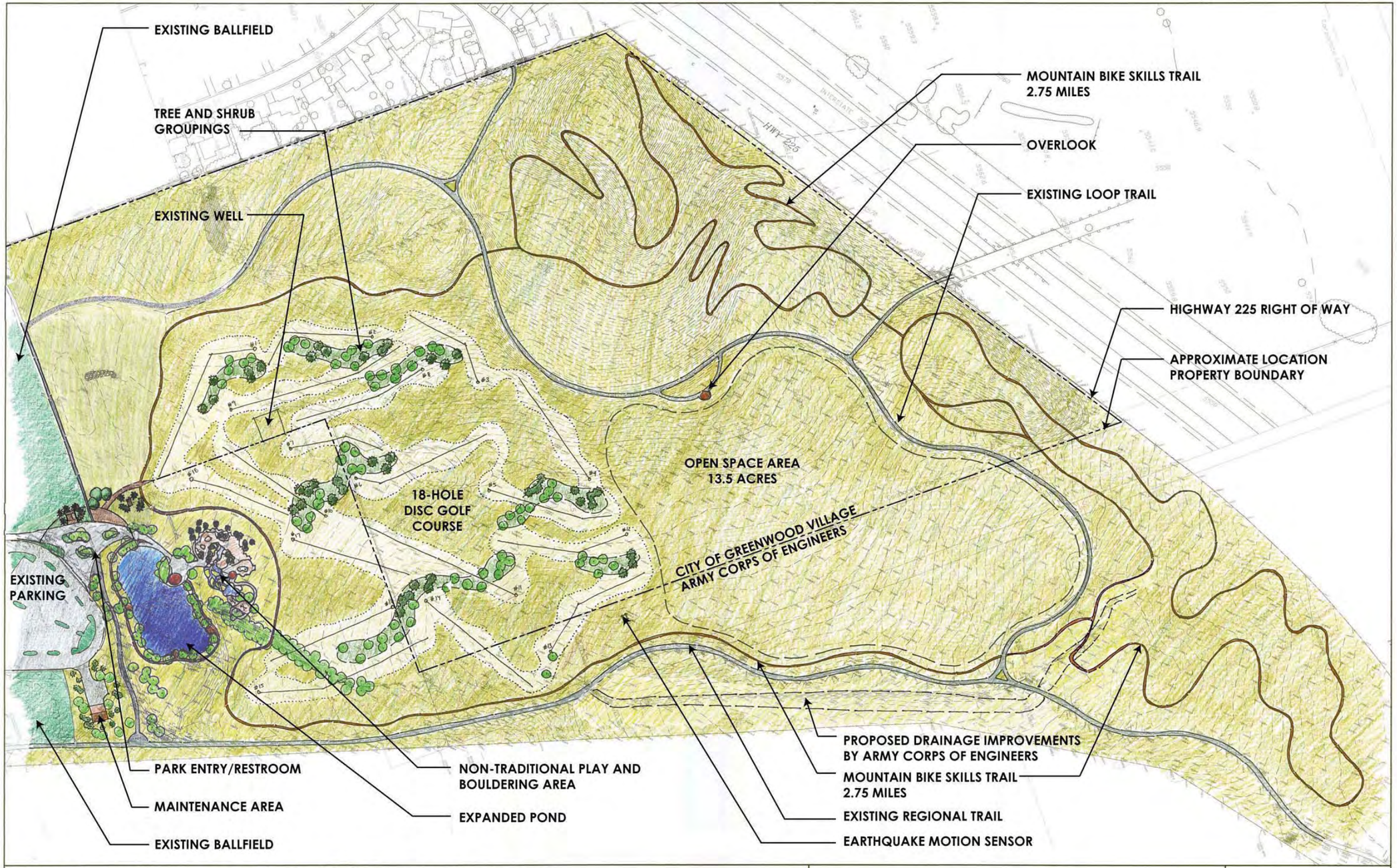
Goals of the plan include:

- Expand the existing pond to increase the irrigation water storage capacity
- Improve the appearance of the existing pond
- Improve the appearance and function of the maintenance area
- Preserve the natural/dryland character of the site
- Provide adventure based park elements such as:
  - A mountain bike skills course
  - A disc golf course
  - A climbing/bouldering area
  - A non-traditional play area

The Site
The parcel of land known as Village Greens North is a largely undeveloped site located immediately north of Village Greens Park. Village Greens North is approximately 90 acres including property leased from the U.S. Army Corps of Engineers. The site is primarily vegetated with dryland grasses. The current amenities on the site include a well that is used for irrigating the park, a small holding pond that stores water pumped from the well, maintenance sheds, an irrigation pump house, a major regional trail along the east edge of the site, and a concrete loop trail that includes connections to Village Greens Park, Cherry Creek Village North neighborhood, and the Regional Transportation District (RTD) light rail station to the north.

THE MASTER PLAN





VILLAGE GREENS NORTH
MASTER PLAN

March 2, 2011

City of Greenwood Village
6060 South Quebec Street
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NORTH SCALE: 1"=100'


NON-TRADITIONAL PLAY AND BOULDERING AREA
CRUSHER FINES LOOP TRAIL WITH PICNIC TABLES AROUND POND
MOUNTAIN BIKE SKILLS TRAIL
RE-ALIGN LOOP TRAIL
TO DISC GOLF
PARK SHELTER
EXISTING IRRIGATION PUMP
"VILLAGE GREENS NORTH" GATEWAY
EXPANDED POND
MOUNTAIN BIKE SKILLS TRAIL AND DISC GOLF TRAILHEAD
EXISTING TRAIL
EXISTING FIELDS
RESTROOM
PARK ENTRY PLAZA/SIGNAGE
"VILLAGE GREENS SOUTH" GATEWAY
RE-ALIGNED LOOP TRAIL
RELOCATED MAINTENANCE AREA
NEW DROP-OFF LANE
EXISTING PARKING AREA
PARKING LOT
MAINTENANCE BLDG
POND
637.39
VILLAGE GREENS NORTH
MASTER PLAN - POND AREA
March 2, 2011
City of Greenwood Village
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NORTH
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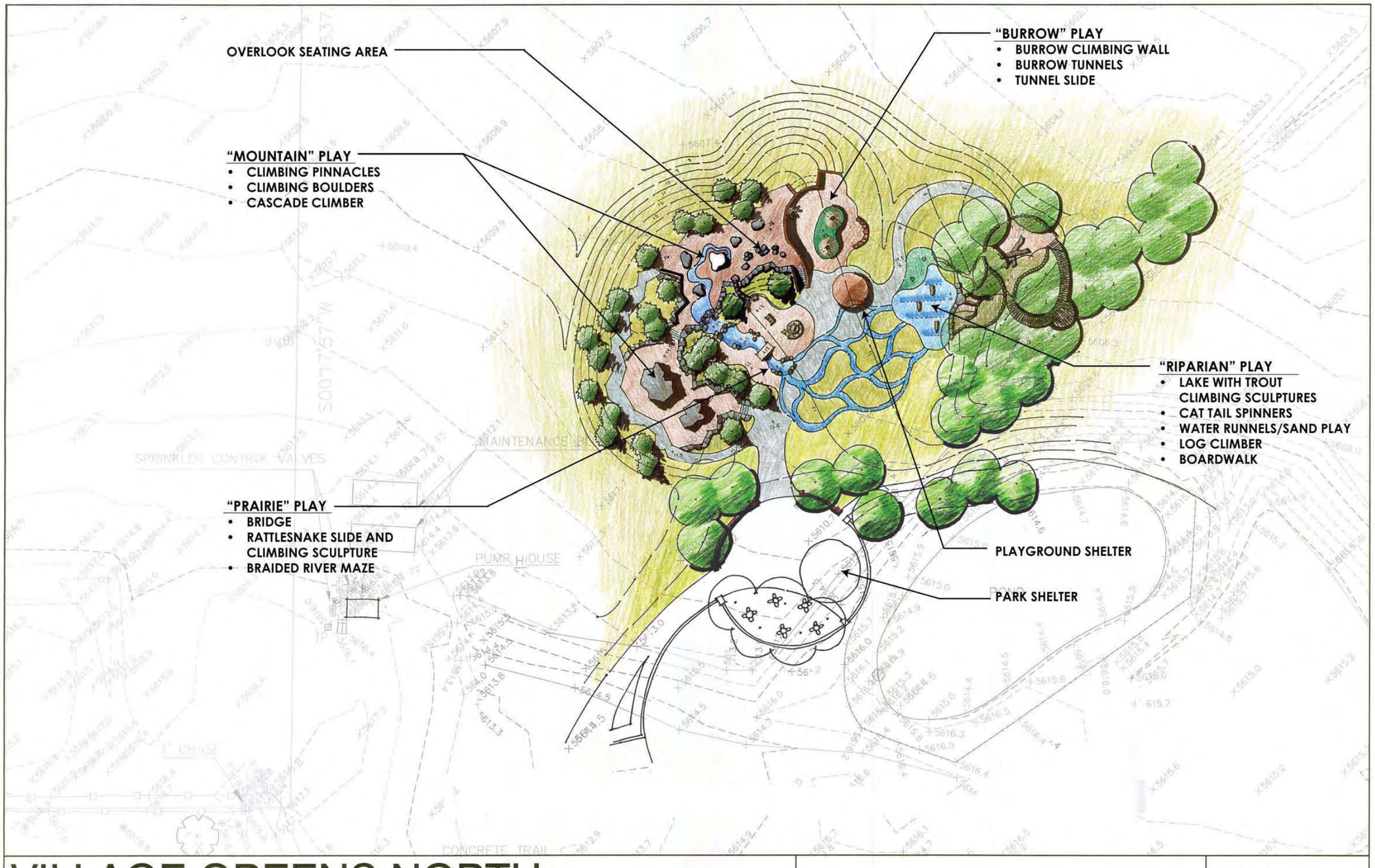
SCALE: 1"=30'



VILLAGE GREENS NORTH

MASTER PLAN

NON-TRADITIONAL PLAY AND BOULDERING AREA

March 2, 2011

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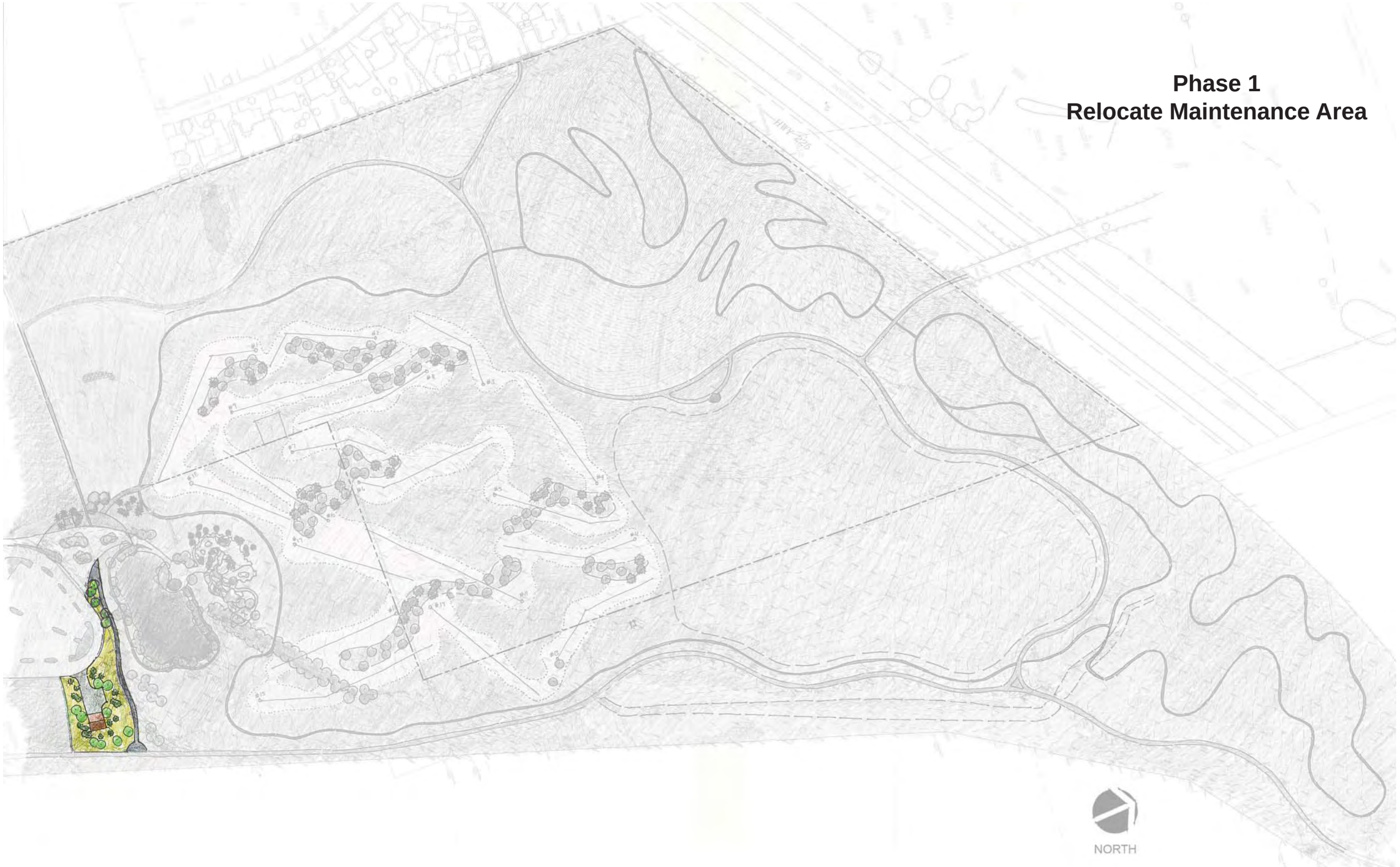
NORTH

SCALE: 1"=20'

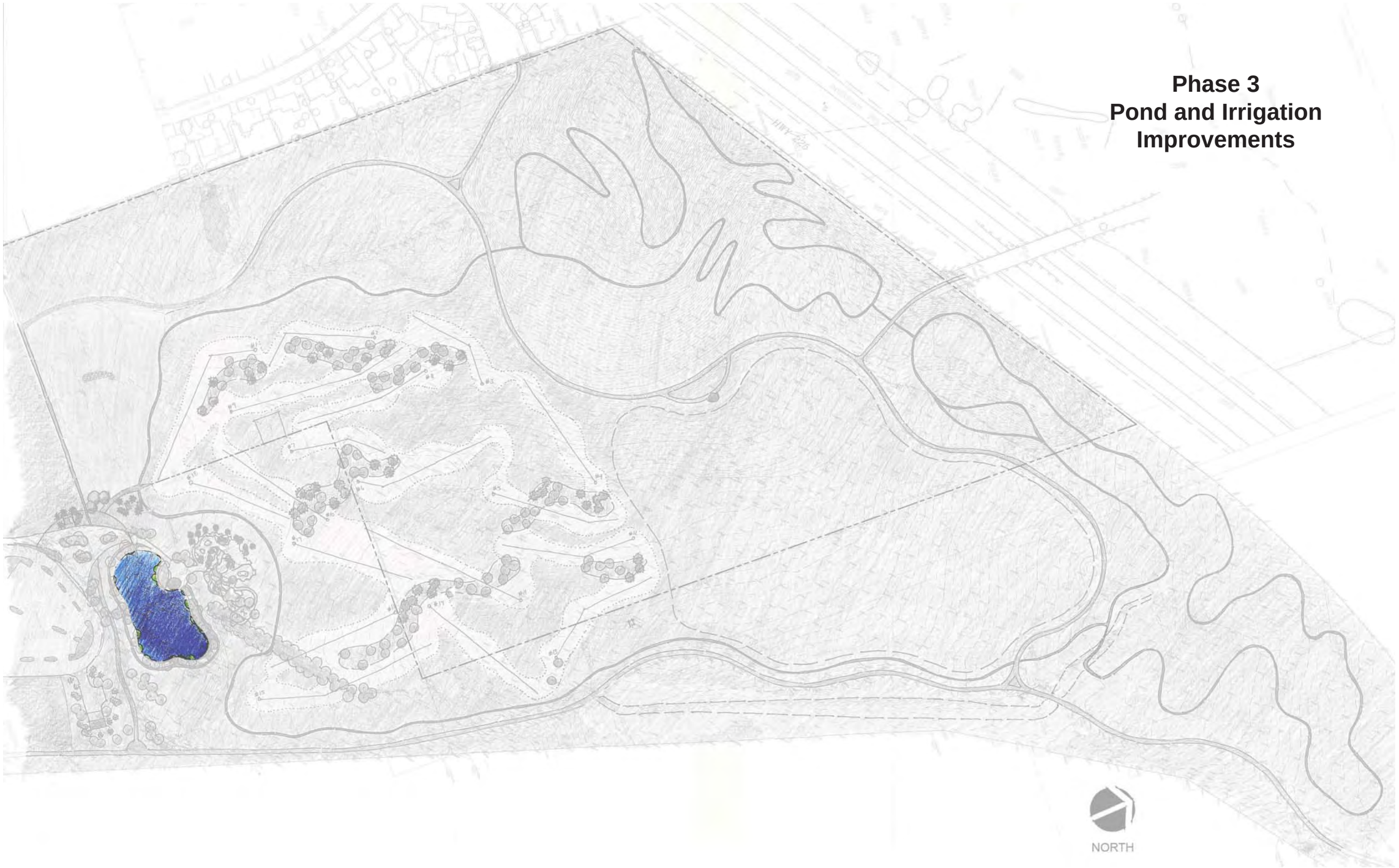
Phase 1
Relocate Maintenance Area



Phase 2
Mountain Bike and Disc Golf Course

NORTH

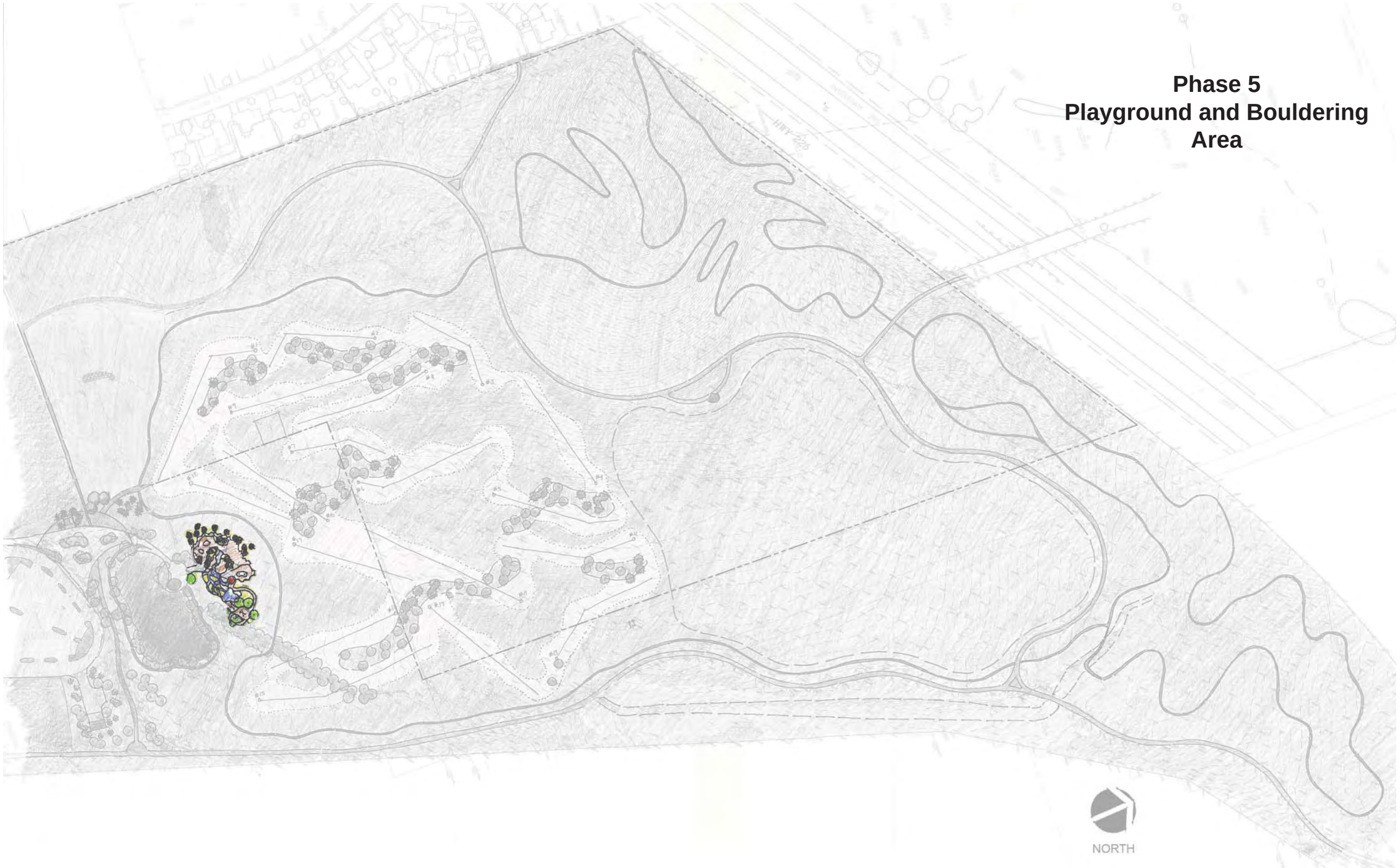
Phase 3
Pond and Irrigation Improvements



Phase 4
Park Entry, Restroom, Shelters, Pond Recreation and Aesthetic Improvements

NORTH

Phase 5
Playground and Bouldering Area



THE MASTER PLAN

The Master Plan

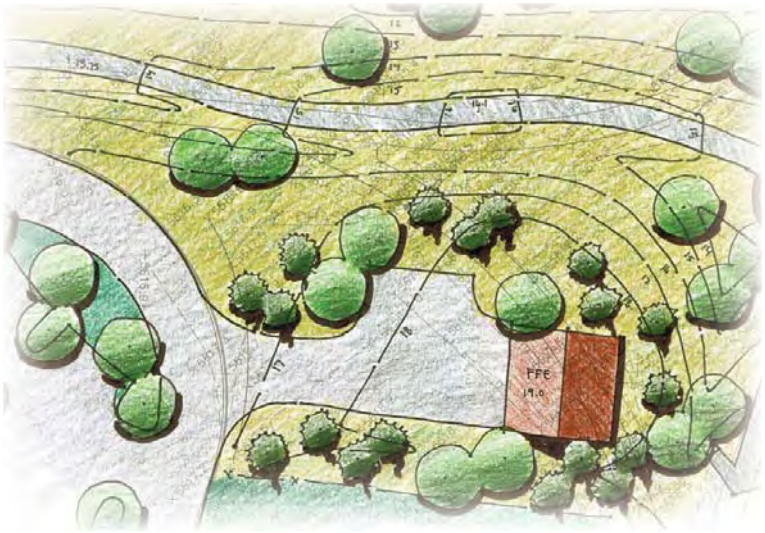
The Village Greens North Master Plan endeavors to meet the goals of the project as stated in the previous section, but also considers and responds to the opportunities and constraints of the site. Ultimately the plan will provide Greenwood Village residents with a park that offers adventure based recreation opportunities that are unique in the Village and uncommon in the Denver metro area.

In addition to providing unique park elements, the plan promotes sustainable park development concepts. The plan promotes water conservation through the use of native and dryland trees, shrubs, and grasses. These plantings are planned to be irrigated with efficient drip irrigation systems. In fact, in the entire 90 acre park, there is no irrigated bluegrass planned. In addition to adhering to sustainable practices, this design preserves and enhances the natural character of the site, and improves ecological diversity.

The master plan includes a phased approach to implementation. As with many large public improvement projects, implementing the entire master plan at once would require a substantial financial commitment. As this may be impractical, the master plan includes a phasing plan that separates the project into 5 phases. The phases were selected based on cost, constructability, and construction access considerations, among other things. See the phasing plans located in the front of this section.

Phase 1
Relocate Maintenance Area

Rather than trying to screen the existing maintenance sheds, the plan proposes removing the sheds and building a new maintenance area at the northeast edge of the parking lot. This new location is in a much less prominent location in the park, and will be easier to screen with landscaping. Providing a new maintenance facility affords the opportunity to provide a more aesthetically pleasing and efficient maintenance building. This location provides easy access into the park for maintenance staff and eliminates the need to drive over park improvements.



One of the existing maintenance buildings houses the irrigation pump. The pump will remain at the current location. The pump building will either be replaced or modified to fit into the surrounding park area.

This phase is intended to be the first built for several reasons. First, the existing maintenance area is planned for other park uses in the master plan, so that land must be vacated before those improvements can be implemented. Also, relocating the facilities will allow the new maintenance area to be built before removing the old, so maintenance staff will have an operational facility throughout the duration of the improvements.

Phase 2
Mountain Bike and Disc Golf Course

This phase is intended to be second to provide a benefit to Village residents early in the project. This phase will provide unique recreation opportunities for residents and will utilize a large portion of the site. In addition, this phase includes work at the northern end of the site where access will be more difficult once other portions of the plan are implemented. Construction of this phase also allows easy access for construction of subsequent phases.

Disc Golf Course (ages 7 and up)

An 18 hole disc golf course is planned for the southern portion of the open space within the loop trail. The course shown on the master plan is about 6,000 linear feet long. That is an average sized disc golf course and will be appropriate for beginner and intermediate players. The intent is to maintain the dryland character of this portion of the site. No site grading will be required for the course. Groupings of native and dryland plants are planned to be added to the area to provide separation between holes, to provide added interest and difficulty for disc golfers, and to provide an ecological benefit. The plantings will be irrigated with drip irrigation.

A disc golf hole consists of a tee, which is a stabilized area about 12'x6', and a target. Concrete is typically the best surface for the tee to provide the best footing. Colored concrete can be used to help the tee better blend into the environment. Small signs will be located at each tee to identify the tee number, and maybe provide a basic map of the hole. The target will be a standard disc golf

chain basket target. These targets visually blend in very well with their surroundings and are difficult to see from a distance, so they will not deter from the natural character of the site.

Because the course will be located in a native grass area, some measures should be taken to prevent excessive wear and trampling of the grasses. A single track path should be created along the center of each hole to help control circulation. One area that typically endures excessive wear is the area around the target. To control this wear, the plan includes a 30' diameter pad of wood mulch around each target.

Mountain Bike Skills Course (ages 10 and up)
A mountain bike skills course starts at the trailhead near the parking lot and loops around the entire park site, with two smaller loops located along the far northern edge of the site. The trail is a total of 2.75 miles in length. The intent is to provide a single track trail experience rather than a freeride or skatepark type facility.

Having the trail sited at the northern end of the site allows trail users to feel as though they are actually going somewhere as they travel along the trail. It also allows the trail to take advantage of some of the steepest topography on the site that can help create additional challenge for the mountain bikers.

The trail will have mountain bike obstacles located at various points along the trail. The obstacles will be made of natural materials like logs and boulders. The obstacles should replicate those that would be found on a typical single track trail in the foothills such as: switchbacks, water bars, log ladders, step up/downs, rock gardens, choke points, log rides, water crossings, drop-offs, etc. Some obstacles could provide options for varying skill levels, and/or a bypass trail.

Open Space

The northern portion of the area within the loop trail is planned to remain as open space for unstructured park recreation and the appreciation of natural surroundings. The prairie dogs on other portions of the site will be passively relocated to this open space area. The size of the unprogrammed area is approximately 13.5 acres. A visual barrier between the disc golf course and the open space will be used to discourage dispersal of the prairie dogs on the disc golf course. The barrier could consist of berming, shrubs, tall grasses, etc.

Phase 3
Pond and Irrigation Improvements

This phase of work will improve the efficiency of the irrigation system. It includes excavating to expand the pond, installing the pond liner, seepage detection system, and modifying the existing outfall from the well and intake from the irrigation pump. This phase will allow the Village to make the best use of water pumped from the well.

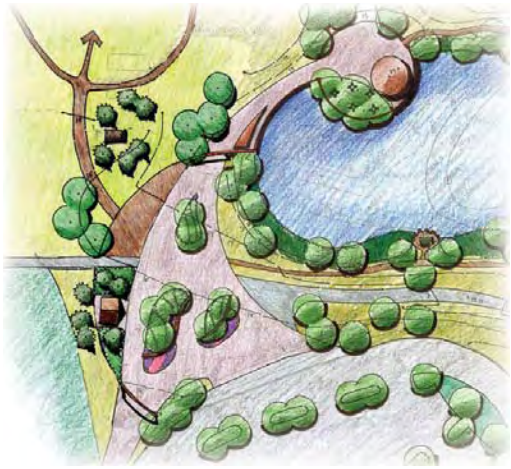
The pond will be expanded to provide additional irrigation water storage capacity which would decrease the vertical drawdown on the pond. The pond is planned to be expanded by 3.5 times from the current 10,000 square feet to about 35,000 square feet. An irrigation system assessment and pond sizing/drawdown analysis report is included in the Supplemental Project Information of this report.

The Village only owns water rights for the water that is drawn from the well, so the pond cannot capture any storm water from the site. This will require careful grading around the pond. The grading shown on the master plan includes a swale around the uphill side of the pond to divert storm drainage away from the pond. It is likely that a drainage system will be required as well.

Phase 4
Park Entry, Restroom, Shelters, Pond Recreation and Aesthetic Improvements

This phase of the project will provide the entrance area to the park and the recreation opportunities that are planned around the pond, as well as the plantings and improved habitat at the pond. Also included are the restroom facility located at the entrance, and the overlook area at the high point of the park. This phase is planned for later implementation to allow easier construction access for the earlier phases.

Park Entry Area
The intent is to provide a designated entry or welcoming area for the park that is not currently provided. This area will serve as an entrance to both Village Greens South as well as the new Village Greens North. The siting of the entry area allows it to be the main point of entry to the park regardless of how one would access the park. Whether arriving from the parking lot, from the regional trail, or from the loop trail, a park visitor would access the park through the entry area.



The entry area would include the following features:

Drop-off lane
The Village does not intend to add additional parking to Village Greens Park with the addition of Village Greens North. The plan includes a drop–off lane added to the north edge of the north parking lot in the existing park.

Entry Gateways
There is an opportunity to celebrate the entrances into Village Greens South and Village Greens North by providing artistic gateways. These gateways could be designed with a theme that suggests the type of amenities provided by that area of the park (traditional sports fields/park elements in Village Greens South, adventure based elements in Village Greens North).

Signage
The entry area would include a "Village Greens Park" entry sign that celebrates the entry to the park. In addition, informational signage such as a park map, trails map, rules and regulations, etc. would be included here.

Trailhead
A trailhead for the disc golf course and mountain bike course is located at the entry area. This eliminates the need for those users, particularly mountain bikers, to ride through other portions of the park to access the mountain bike course or disc golf course.

Seating Areas
Seating areas should be included to provide resting opportunities for people waiting to be picked-up, etc. These areas could respond to the adventure based feel through the use of boulders or could be comprised of traditional site furniture.

Restroom Facility
A restroom facility is planned to be included at the entry area. This location would serve both Village Greens South and Village Greens North. The facility is planned to be an evaporative vault system rather than a plumbed restroom facility. These facilities have a fan and pipe system that evaporates liquids in the vault, nearly eliminating odors, and greatly reduces the frequency of pumping out the vault.

Landscaping
Landscaping including shade trees, ornamental trees, evergreen trees, shrubs, and perennials should be included to provide beauty and comfort for visitors. The landscaping in this area will be more formal than the landscaping planned for other portions of Village Greens North.

Pond Area
The expansion of the pond that is planned in Phase 3 provides opportunities to improve the aesthetics of the pond as well as providing additional recreation opportunities. The intention is to create a natural aesthetic for the pond rather than a hard edged, urban aesthetic.

These recreation and aesthetic improvements are planned to take place in Phase 4 and include:

Shelter/Picnic Area
There is a seating area that includes a shelter, shade trees, and picnic tables located on the edge of the pond. This feature was added as a result of requests during the first public meeting. The intent is to provide a wall and railing so park visitors can be directly adjacent to the pond. This is the only area where the pond is planned to have a "hard" edge. There is an opportunity to have a custom designed shelter that will be a unique amenity and reflect the natural character of the site.

Wetland/riparian plantings
Wetland and riparian plantings are planned around the edge of the pond. The intent is to provide a variety of plants that will offer visual and ecological diversity and a natural appearance. The depth of the pond will be increased to eliminate the cattail marsh that has overtaken the existing pond.

Loop Trail/Water Access Areas
A soft surface loop trail will be installed around the pond. At specific locations, the trail will provide access through the vegetation to seating areas at the edge of the pond. The seating areas could include a log or boulders for seating, or picnic tables.

Landscaping
Upland landscaping surrounding the pond will include shade trees and shrubs. The layout of these landscape improvements will not be formal, but will appear to be natural groupings of dryland shrubs and trees.

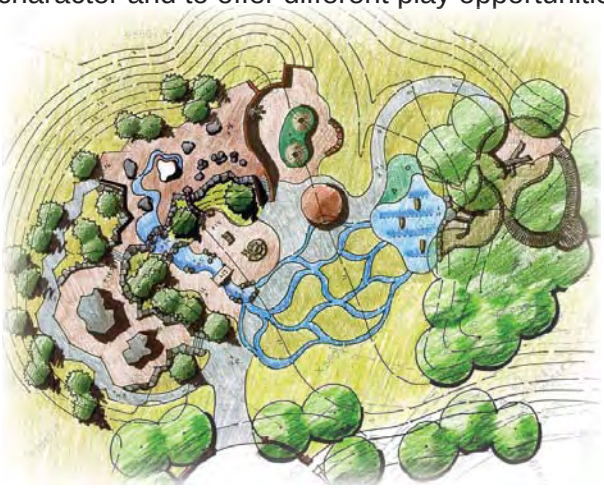
Overlook
An overlook/seating area is planned for the high point of the site that is discussed in the opportunities and constraints portion of the report. The overlook will provide a rest area for trail users along the loop trail. People using the overlook will have spectacular views of the mountains and of most of Village Greens North. There is also an opportunity to provide interpretive signage regarding ecosystems, habitats, wildlife, etc.

The overlook could include a custom shelter that would be similar to the shelter at the pond. This would provide some visual continuity across the park site and provide a distant point of interest to draw people into the site from the parking area. It will also provide a point of interest that will be visible from various points outside the park.

Phase 5
Playground and Bouldering Area
(Playground: ages 2-12; Bouldering Area: ages 10 and up)

The intent of this area is to provide an adventure based play environment where children are encouraged to explore, experiment, and discover the landscape around them. This will not be a traditional playground with swings, jungle gyms, etc. The play features will have a natural/adventure theme and will be made of primarily natural elements. The entrance to the play area is near the park entry area.

The concept for the design of the play area is to follow the path that water takes while flowing from the mountain tops of the Front Range down to the prairie. The play area is designed with 3 distinct play zones that represent different environments along the path of the water: mountain, prairie, and riparian. The intent is for each of these areas to have a very different character and to offer different play opportunities.



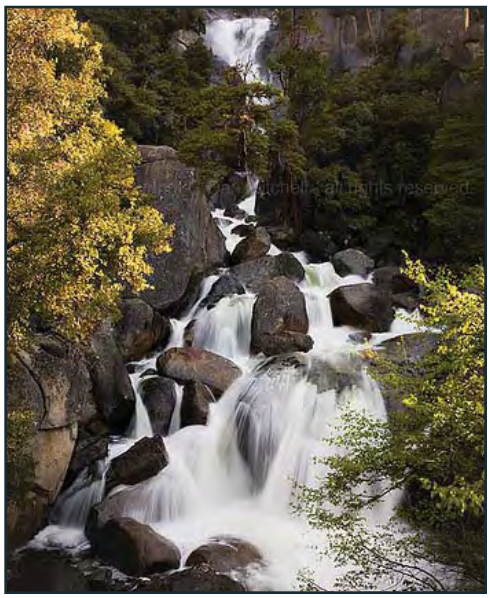
Mountain Play Zone
The mountain play zone is physically higher than the rest of the play area. Since it is sited on the west side of the play area, the berming around the zone will screen most of the play area from the Cherry Creek Village North subdivision. The mountain play zone will be planted with evergreen trees and the border of the play area could be lined with boulders to develop the “mountain” character.

The mountain play zone is separated into two parts, one with climbing pinnacles, another with climbing boulders.

The climbing pinnacles are planned to challenge older children and adult climbers. They should be made with climbing routes of varying difficulty to challenge novice as well as experienced climbers. The climbing pinnacles are planned to be constructed from glass fiber reinforced concrete (GFRC) or a similar material. This is a concrete material that is colored to replicate stone. The pinnacles can be 10' to 12' tall or taller and provide climbing challenges such as arches, chimneys, and over vertical pitches.

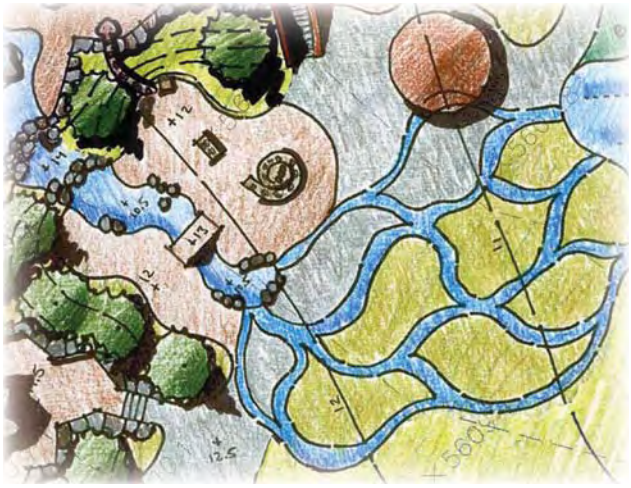
The other climbing area will include natural stone boulders that will offer similar opportunities for children, but on a smaller scale. A few of the boulders will be made of white marble to represent snow and ice at the top of the mountain. A simulated run-off stream will flow from these white boulders. The stream will be represented with blue rubberized surfacing. The surfacing will flow to the edge of the play area where it enters a "cascade".

The cascade is a climbing structure that will connect the mountain play zone to the prairie play zone. As previously stated, the mountain zone is several feet higher than the rest of the play area. The cascade will be a boulder climbing feature with blue rubberized surfacing "flowing" between the boulders representing the water rushing down the mountainside.



Prairie Play Zone

The prairie play zone is planned to be a flat play zone mostly planted with native and ornamental grasses to evoke the character of the prairie. Once the “stream” leaves the cascade, it passes under a bridge that children can explore by walking over or crawling under.



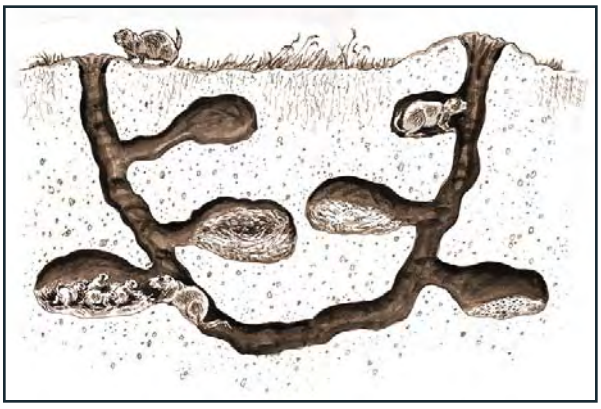
A grass maze inspired by the wide, braided rivers in the prairie offers a different exploration opportunity. Braided paths wind through tall ornamental grasses to provide a sense of adventure and mystery. The paths represent the water and could be represented with Lithocrete®, a concrete pavement with colored glass pellets set into the surface to provide a shimmering blue finish.

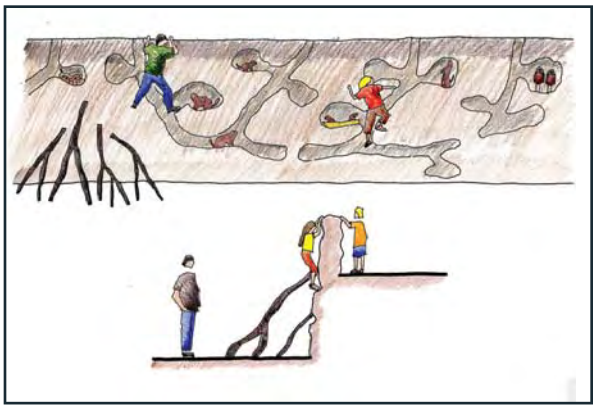
Another play opportunity in the prairie zone is a rattlesnake feature. The coiled body of the snake would provide climbing opportunities. A section of the body of the snake could be a tunnel for kids to crawl through. And finally, another portion would be a tunnel slide that connects the mountain play area to the prairie play area. The entrance of the slide could be sculpted to look like a snake’s mouth. The rattlesnake feature could also be made of GFRC to provide a realistic color and texture of a rattlesnake’s body.

Burrow Play Area

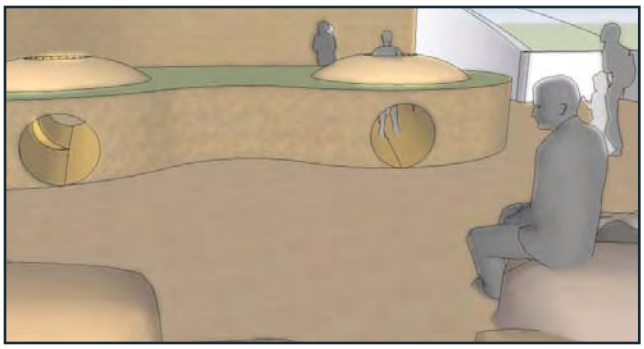
Another portion the prairie play zone is the borrow play area, which is inspired by the prairie dog colonies on site.

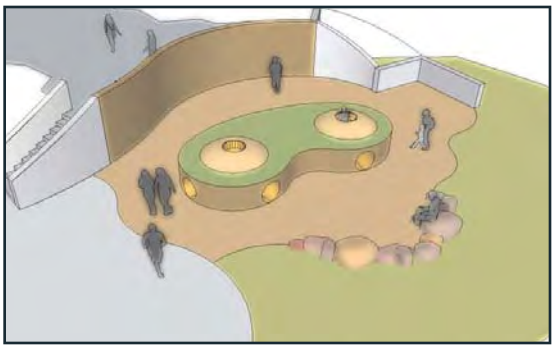
The burrow play area includes a climbing wall, but rather than replicating the appearance of stone, the goal is to have the wall appear to be a cross section of the prairie soil. The wall would represent the underground tunnels and rooms in a prairie dog colony, as well as some of the animals that use burrows, such as prairie dogs, snakes, mice, and burrowing owls. This represents an opportunity to passively educate children about their surroundings. Climbing to the top of the wall provides access to the mountain play zone, and a tunnel slide provides access back to the burrow play area.





In addition, the area includes a child size burrow, where kids could crawl through a tunnel, and climb out through the top like a prairie dog burrow.





Riparian Play Zone

The riparian play zone is located at the lowest point in the play area, and is located near an existing wooded drainage from the existing pond. The location allows the riparian play zone to benefit from the shade and character of the existing trees. Additional shade trees would be planted, and the zone could be lined with logs to strengthen the riparian character.

The paths from the braided stream maze in the prairie zone run into a simulated pond. The pond is planned to have blue rubberized surfacing, and the surface will undulate like waves to offer a different surface to explore. The design of the pond includes climbing sculptures of jumping trout. These could be made of GFRC, carved stone, or a variety of other materials.

Adjacent to the pond is a sand play area that could have a water spigot and runnels. This would provide children with an opportunity to build, dig, and create things with sand, and explore how water and sand interact in the runnels.

Another feature in the riparian play zone is a log climbing structure. The intent is to provide one or two natural logs for children to climb on and explore.

Finally, the riparian play zone includes a boardwalk that extends over the existing wooded drainage. Because of the elevation change, the boardwalk would be in the canopy of the trees and provide a similar experience to being in a tree house.

Seating Areas

There will be opportunities for seating throughout the play area to give parents a place to rest while watching their children. The plan includes a shelter centrally located in the play area. Other opportunities for seating could include boulders, logs, or site furniture at various locations throughout the play area.

CONSTRUCTION COSTS, MAINTENANCE COSTS, AND IRRIGATION SYSTEM INVESTIGATION

CONSTRUCTION COSTS, MAINTENANCE COSTS, AND IRRIGATION SYSTEM INVESTIGATION

Construction Cost Estimates

A preliminary estimate of probable construction costs was prepared for the master plan. The estimate is based on the master plan, assumptions about what materials may be used for the project, and our experience with similar projects. The estimate is in "2011 dollars". Inflation should be included in budget planning for phases that are implemented in later years. The preliminary estimate of probable construction costs is included in the back of the report in the Supplemental Project Information. In summary:

Phase 1	Relocate Maintenance Area	$ 286,000
Phase 2	Mountain Bike and Disc Golf Course	$ 535,000
Phase 3	Pond and Irrigation Improvements	$ 365,000
Phase 4	Park Entry, Restroom, Shelters, Pond Recreation and Aesthetic Improvements	$1,004,000
Phase 5	Playground and Bouldering Area	$1,046,000
TOTAL		**$3,236,000**

Maintenance Cost Estimates

Village Greens North is currently maintained as open space at a cost of approximately $100,000 annually. The largest component of that cost is both contracted and staff performed weed control. The Village also provides mosquito and pest control and removal of trash, snow, and pet station waste from the park. Developing Village Greens North as proposed in the master plan will increase the annual cost of maintaining the park by approximately $50,000 annually. The estimated annual cost of each major component is listed below.

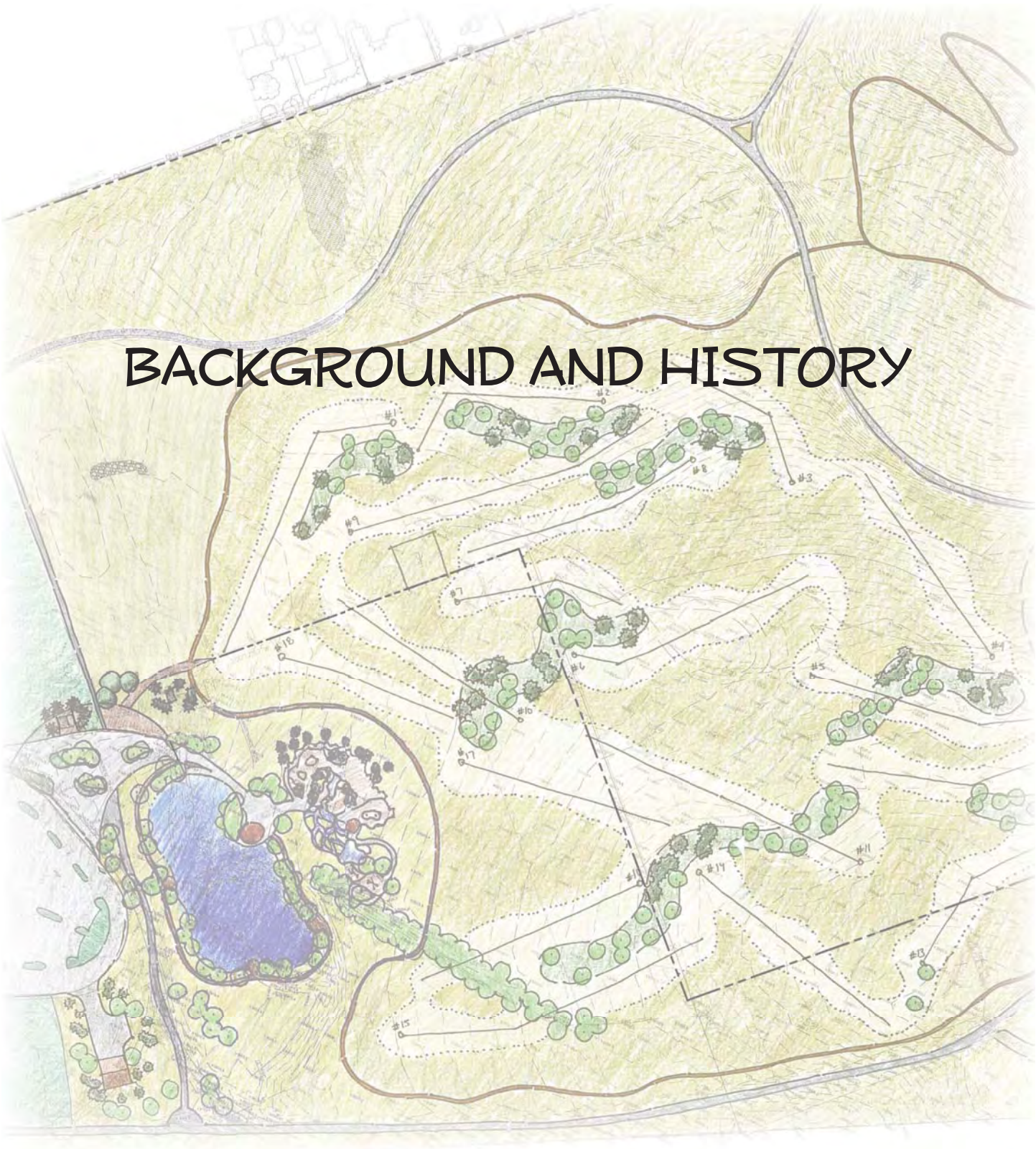
Estimated Annual Maintenance Costs

Current maintenance cost		$100,000
Phase 1	Relocate Maintenance Area	comparable to current maintenance
Phase 2	Mountain Bike Skills Course	$ 14,800
	Disc Golf Course	$ 11,200
Phase 3	Pond and Irrigation Improvements	$ 2,000
Phase 4	Park Entry, Restroom, Shelters, Pond Recreation and Aesthetic Improvements	$ 12,000
Phase 5	Playground and Bouldering Area	$ 10,000
TOTAL		**$150,000**

Irrigation System Investigation

A detailed irrigation system assessment, including a pond sizing/draw down analysis, gallon per minute demand calculation, and water budget was prepared as part of the master plan. That report is included in the back of this document in the Supplemental Project Information.

BACKGROUND AND HISTORY



BACKGROUND AND HISTORY

There have been several proposals and preliminary plans developed for uses on this parcel of land over the years. For various reasons, these plans have not gained the support of City Council. Below is a brief history of the site and some of the planning efforts that have been completed prior to this master planning effort.

1960's & 1970's
The property was farmland used by the Cherry Creek School District agricultural program.

1983
Greenwood Village acquired the park property (approx. 52 acres) through an annexation. In addition, the Village preserved additional open space through a lease agreement with the U.S. Army Corps of Engineers to maintain an adjacent 33.6 acres of contiguous open space located on the east side of the property.

1990's
Discussions about how the land should be developed included active uses for the site such as a golf course or athletic fields. City Council earmarked funds by Resolution for a golf course. However, subsequent City Councils transferred portions of the funds to different Village projects.

1995
The Village entered into an agreement with Cherry Creek Water District which stated that the Village desired to construct, build and irrigate a golf course.

1997
The Village undertook an effort to develop four alternative concept plans for the park. At Council's direction, none of these plans included a golf course. Ultimately, there was no direction given by City Council to proceed with any of the proposed plans.

2003/2004
Following the public input phase of the Comprehensive Plan Update, City Council and the Parks, Trails and

Recreation Commission determined it was necessary to address the noise and sight impacts of I-225 on the Cherry Creek Village North neighborhood. 300,000 cubic yards of dirt were imported to the site to build a berm in conjunction with the Transportation Expansion (T-REX) project. The 2004 Greenwood Village Comprehensive Plan Update identified several objectives for the Village Greens North property:

- Develop Village Greens Park with uses and/or buffering treatments that are compatible with the planning area.
- Develop pedestrian connections through the park to light rail, Cherry Creek Dam Trail, and other elements of the Village Trail System.
- Enhance the planning area connectivity to the Cherry Creek State Park.
- Minimize noise impacts from I-225 through noise abatement programs.
- Protect planning area views of the Cherry Creek Reservoir.

Concurrently, the Village undertook another effort to develop a design for Village Greens North. Ultimately, Council only authorized the first phase of the developed plan which included two earthen berms to screen I-225 from Cherry Creek Village North, and a concrete loop trail with connections to the RTD light rail station and Cherry Creek Village North neighborhood. These improvements were constructed in 2005.

2006

The Village prepared a management plan for prairie dog colonies on four open space and park properties in the Village, including Village Greens North. Village Greens North was the only area not recommended for prairie dog relocation and was also identified as the only area suitable for prairie dog colonies. The site survey found that the area is home to two prairie dog colonies as well as burrowing owls.

2007

The Village undertook another planning effort to identify alternatives for improving the aesthetics, function, and efficiency of existing park elements including the irrigation pond, pump house, maintenance area, and well. Two alternatives were developed, but ultimately neither received the support of City Council. Council then directed Village staff to develop a master plan for the park.

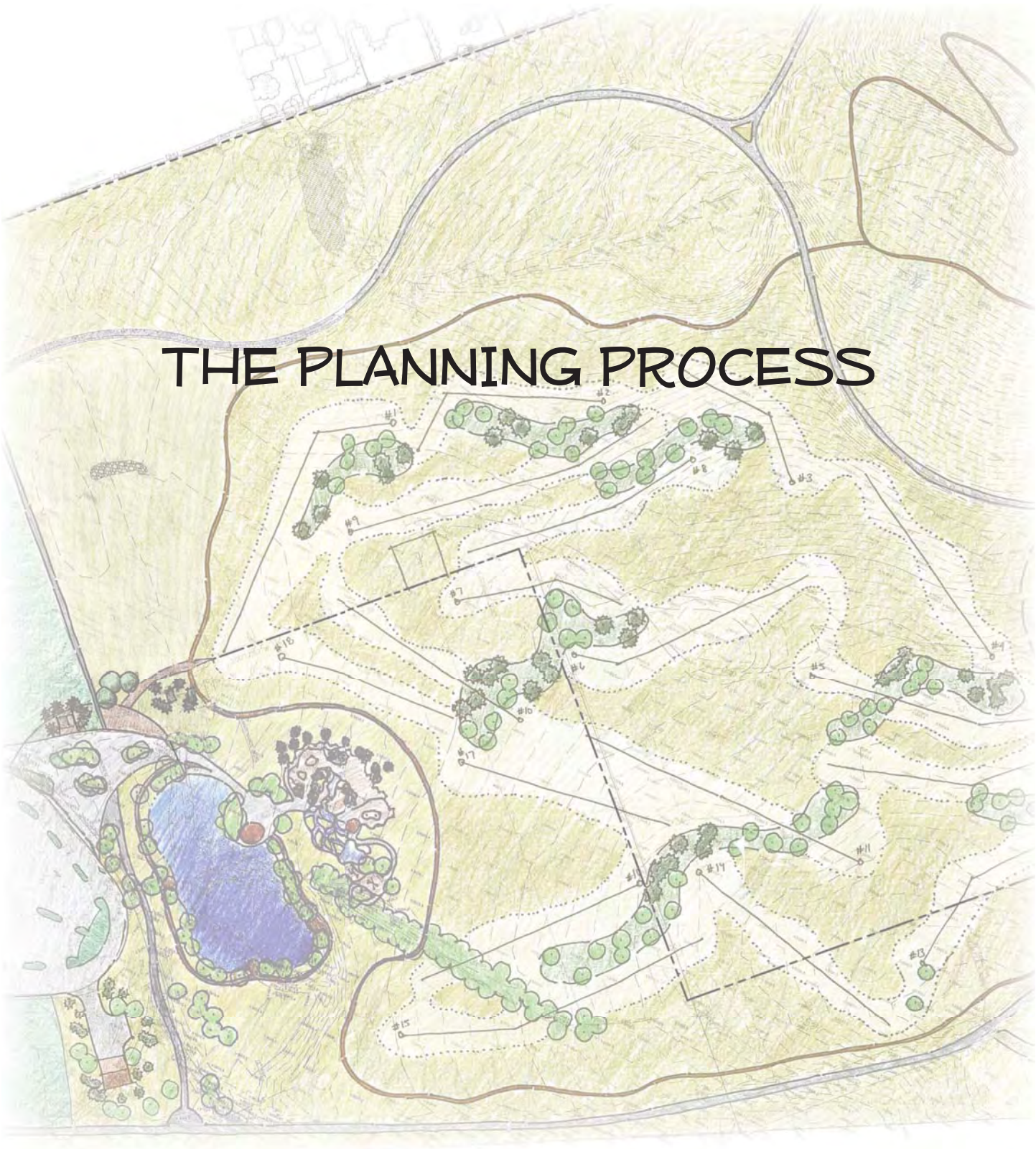
2008

Staff received a request from District Four Councilmember, Gary Kleeman to explore options for integrating a rock climbing feature, adventure disc golf course and mountain bike trail into the park.

2009

The Village started the planning effort that has resulted in this plan and report.

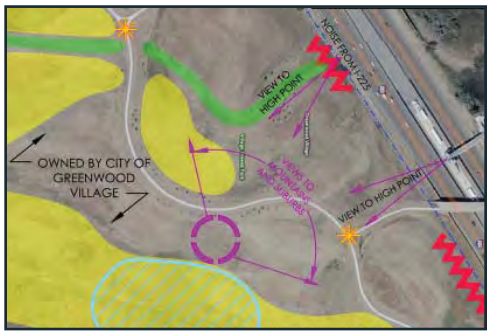
THE PLANNING PROCESS



THE PLANNING PROCESS

The master plan was developed through a collaborative process that included input from the citizens of Greenwood Village, coordination with the U.S. Army Corps of Engineers, and direction from Village staff, City Council, and the Parks, Trails, and Recreation Commission. The planning process included the following key steps:

Kick-off meeting (September 2009)
During the meeting, Village staff shared the Village's goals, requirements, and concerns for the project. A general schedule for the project was discussed.



Opportunities and Constraints Plan (Fall 2009)
An opportunities and constraints plan was developed to understand the site and help guide the design of the master plan. The Opportunities and Constraints Plan is detailed on pages 27 through 29.

Concept Plan (Fall 2009)
The concept plan was developed to determine where the different park elements should be located to best suit the opportunities and constraints of the site and to best meet the user's needs.

The concept plan was reviewed with staff prior to the first public meeting. Ultimately, the concept plan set the general layout of the park elements for the master plan.

The concept plan is included in the Supplemental Project Information section.

Public Meeting #1 (January 2010)
A public meeting was held at Cherry Creek Presbyterian Church to inform the public about the goals of the project, and to solicit public comment on the work completed to date. Village staff and the consultant team presented a brief history of the site, the goals of the project, the opportunities and constraints plan, and the concept plan. In general the public was supportive of the plan.

Meeting notes from the first public meeting are included in the Supplemental Project Information information section.

Site visit to review disc golf courses (March 2010)
Village staff and the consultant team visited three disc golf courses to observe the character of the courses and to review what works or doesn't work well at the current

courses. The courses visited were: David Lorenz Park (South Suburban Parks and Recreation District), Schaffer Athletic Complex (Foothills Parks and Recreation District), and Birds Nest Disc Golf Course (City of Arvada).

During the site visit we observed that grass was often worn to bare dirt around high traffic areas such as the tees and targets. We noted that a single track path from the tee to the target and between the holes appeared to control wear patterns on the course.

There had been some previous discussions about whether the course should utilize standard disc golf chain basket disc catchers, or if the targets should be natural items such as trees, rocks, logs, etc. Standard disc catchers were used at all of the courses that we visited. We noted that the standard disc catchers blend in very well and were actually difficult to see from a distance. We also spoke with John Bird who manages the Bird's Nest Disc Golf Course. He recommended using standard disc catchers because there is additional challenge in getting a disc into the basket and they are less likely to damage a disc. Also, if a target is a tree or rock, players may decide to select a different target and may use the site in ways that were not intended.

Preliminary Master Plan (Winter/Spring 2010)
A preliminary master plan was developed utilizing the basic layout of the concept plan. The preliminary master plan added significantly more detail, including specific sizes and shapes for various elements of the plan, site grading, and inspirational images. This plan included detailed plans for the park entry area, and the play area.

The preliminary master plan is included in the Supplemental Project Information section.

Staff review meeting (April 2010)
The consultant team presented the preliminary master plan to parks, engineering, and maintenance staff. No specific concerns were expressed about maintenance for the park.

Review meeting with District 4 Council Members (May 2010)
Village staff and the consultant team presented the plan to District 4 Council members at City Hall in early May, 2010. In general, the Council members were pleased with the direction of the design. They offered some suggestions for renaming certain elements of the plan. They also expressed a concern about portions of the play area being somewhat hidden from view.

Revisions to the plan as a result of the comments included renaming elements of the plan and adding a seating/observation area at the high point of the play area where parents would have views over the entire play area.

Review meeting with U.S. Army Corps of Engineers (Corps) (July 2010)
Village staff had previously sent the preliminary master plan for the park to the Corps for their review and comment. This meeting was held to review the Corps comments on the master plan.

The Corps was primarily concerned about drainage at the toe of the Cherry Creek Dam. They are currently preparing plans for drainage improvements at the toe of the dam to correct existing drainage problems. The Corps requested that their proposed drainage project be shown on the master plan. They required the expanded pond shown on the preliminary master plan be adjusted so that the expanded pond is no closer to the dam than the existing pond. They were concerned about seepage from the pond adding additional water to the area around the toe of the Cherry Creek Dam and masking drainage problems associated with the dam. They required a submittal to include methods to prevent and detect seepage. Finally, they wanted to have the earthquake motion sensor labeled on the plan and ensure that no earthwork or other disturbance would occur within 100' of the sensor.

The plans were revised to reflect these comments. The revised plans and pond seepage submittal were resubmitted to the Corps in August, 2010. The submittal is included in the Supplemental Project Information section.

The Village received approval of the master plan from the Corps with minor comments in December, 2010. This response is included in the Supplemental Project Information section.

Public Meeting #2 (March 2011)
The second public meeting was held at City Hall. Village staff and the consultant team presented a brief review of the process for the project to date and presented the preliminary master plan in detail. Estimated construction costs and potential phasing options were also discussed. In general, the public was supportive of the plan.

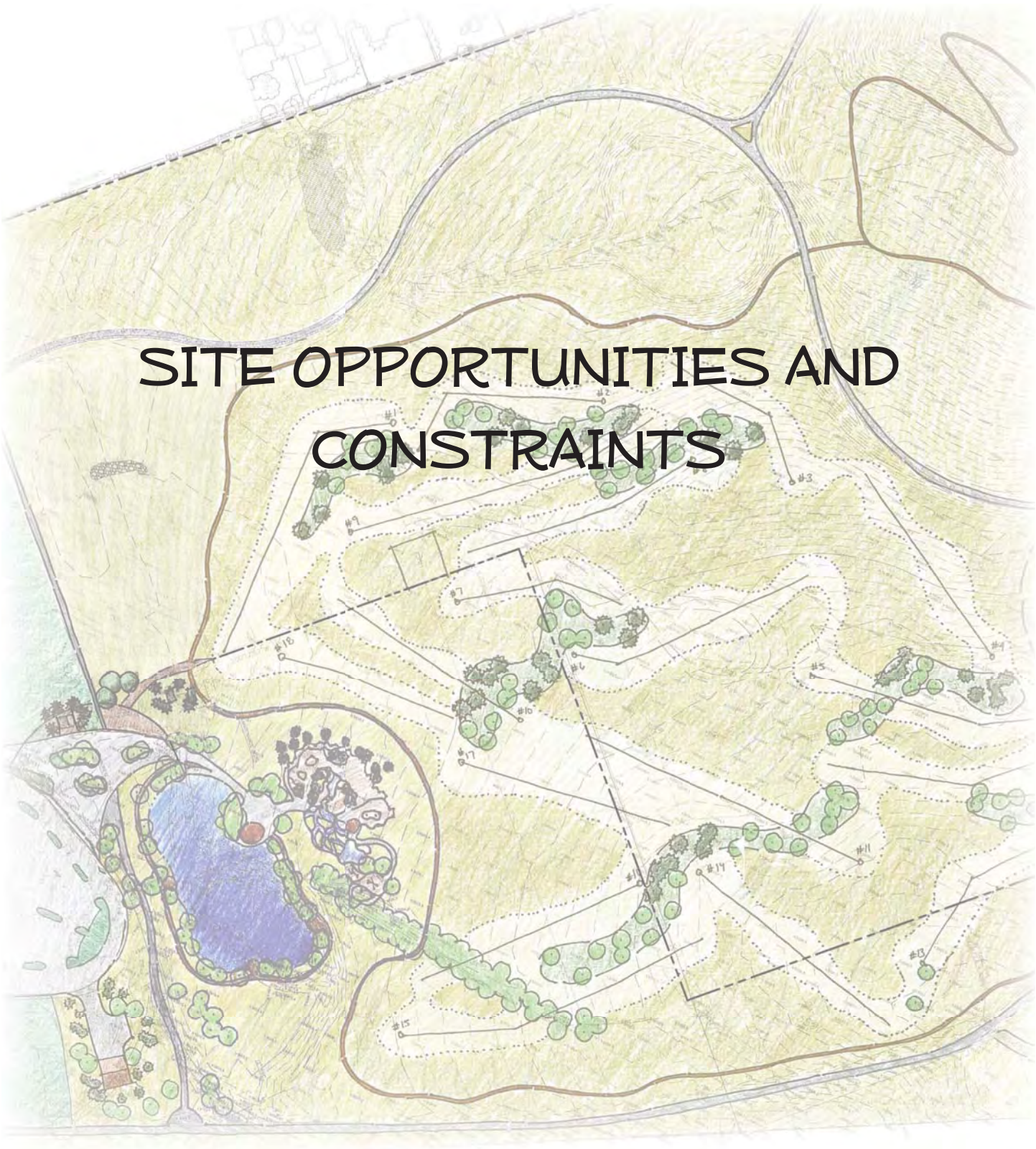
Changes to the plan based on feedback from this meeting were to realign the loop trail to utilize the existing trail north of the existing ballfields. This also prompted a small redesign of the entry area to accommodate the new trail alignment.

Meeting notes from the second public meeting are included in the Supplemental Project Information section.

Parks, Trails, and Recreation (PTR) Commission Meeting (March 2011)
Village staff and the consultant team presented a brief review of the design process to date, and presented the preliminary master plan in detail. Estimated construction costs and potential phasing options were also discussed. There was some discussion about different elements of the plan. There was discussion regarding the play area and whether or not it is too complex for this type of park. There was discussion about

whether some of the phasing should be re-prioritized as well. At the conclusion of the meeting, the PTR Commission voted unanimously to support the plan, with the provision that prior to each phase, the plan will be brought to the public, the PTR Commission and City Council to review the detailed design.

Council Study Session (April 2010)
Village staff and the consultant team presented a brief review of the design process to date and presented the preliminary master plan in detail. There was some discussion about different elements of the plan as well as costs for constructing and maintaining the park, and funding alternatives. Finally, there was discussion of exploring the option to combine phases 1 through 3 into a single phase in an effort to address the irrigation and maintenance facility issues and also provide a recreation benefit for the public at an early stage of the project. In addition, combining multiple phases as a single project should result in lower construction costs due to the economy of scale. At the conclusion of the meeting, all present Council members expressed support for the plan.



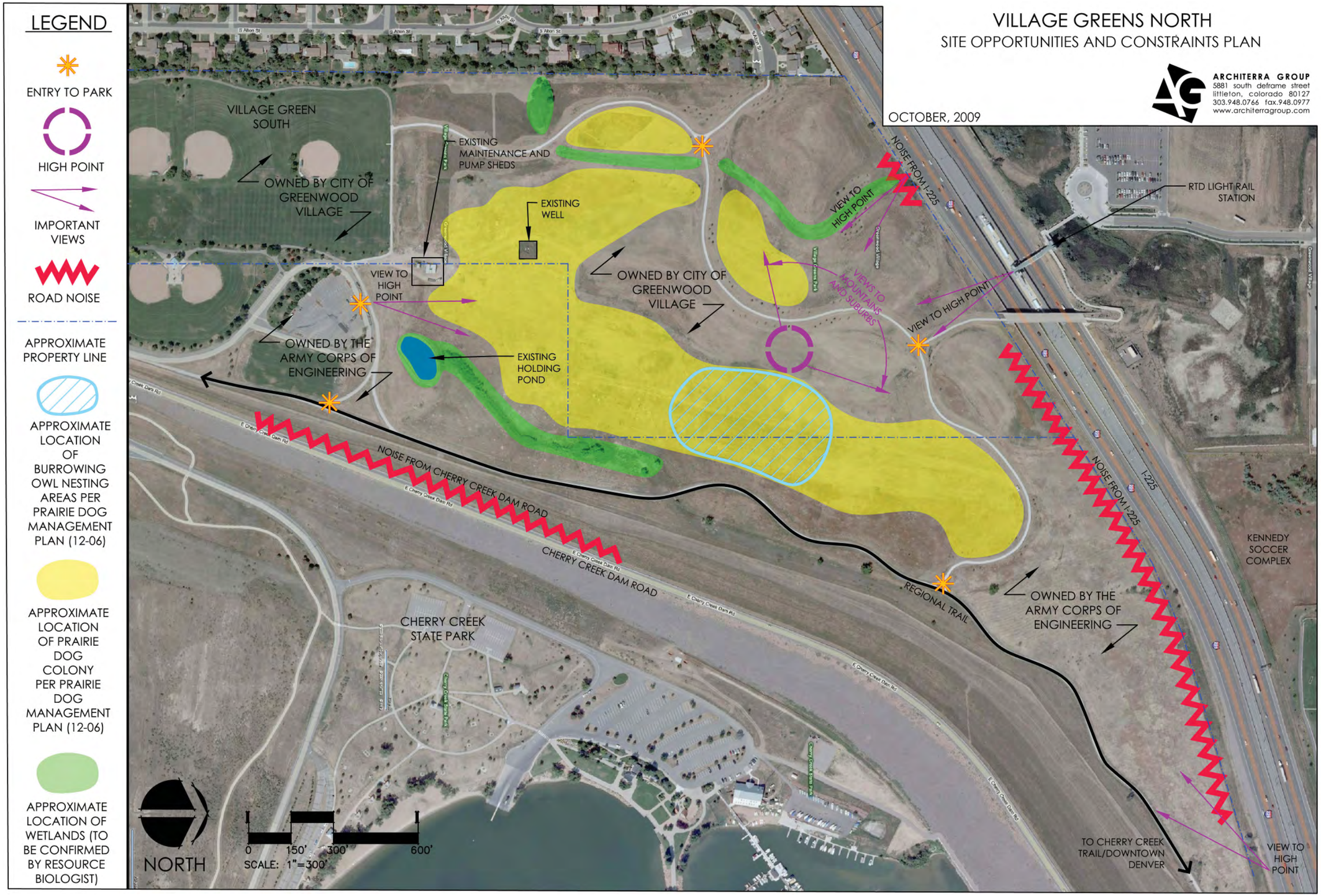
SITE OPPORTUNITIES AND CONSTRAINTS

VILLAGE GREENS NORTH

SITE OPPORTUNITIES AND CONSTRAINTS PLAN

ARCHITERRA GROUP
5881 south deframe street
littleton, colorado 80127
303.948.0766 fax.948.0977
www.architerragroup.com

OCTOBER, 2009



SITE OPPORTUNITIES AND CONSTRAINTS

The first task in the planning process was to review the site and prepare an opportunities and constraints plan. The purpose of this plan was to identify characteristics of the site that informed the overall design of the park. The plan identified the following items:

Physical Characteristics

Surrounding Uses

The site is bordered by I-225 to the north. The noise from I-225 is mostly noticeable toward the north end of the site. Cherry Creek Dam borders the site to the east. There is some noise from traffic on Cherry Creek Dam Road mostly noticeable at the south east end of the site. The site is bordered by Village Greens South on the south. The west side of the site is bounded by the Cherry Creek Village North subdivision.

Aesthetics

The site has a pleasant rolling characteristic with varying slopes across the site. In general, the site has a nice stand of dryland grasses with some areas where the vegetation has been denuded due to the prairie dogs on the site. The trees and shrubs on the site appear to be healthy and provide nice aesthetic and ecological variety along the loop trail. There are two areas with wetlands on the site: the holding pond with an associated drainage, and a drainage basin on the west side of the site.

Slopes

The site generally slopes from south to north. There are two drainage basins on the site that are generally separated by a north-south ridge. The site has a rolling nature that limits long range views from portions of the site. In fact, there are very few locations from which you can see the entire site. The varying slopes provide opportunities for many of the potential park elements.

Viewsheds

The Cherry Creek Dam is the dominant landscape feature to the east of the site. From some locations on the site, there are nice views toward the mountains west of the site, and towards the suburbs north of the site.

High Point
The high point of the site is located just inside the loop trail toward the north end of the site. This point has wonderful views of the surrounding area including views to Longs Peak, the Indian Peaks Wilderness, and Mt. Evans. In addition, this location is visible from the parking lot at Village Greens South, from the RTD light rail station, and from I-225 east and west. There is an opportunity to provide a seating/viewing area at this point. An artistic element could be incorporated in this area that may create a visual identity for the park since this is a highly visible area.

Water Quality
There is currently a detention/water quality basin located at the south end of the site that accepts drainage from the bluegrass fields in Village Greens South. There are certainly opportunities to provide further water quality improvements in the development of the new park.

Existing Features

Irrigation Holding Pond
Increasing the size of the pond offers several opportunities to improve the appearance of the pond. The existing pond is shallow and is mostly filled with cattails. Modifying the pond will provide opportunities to vary the depth of the pond to control the cattail growth and provide open water. The edges of the pond also present an opportunity to provide varied plantings that will offer better visual interest and improved ecological function.

Irrigation Components
There is a well on site that provides irrigation water for the park. The well will have to remain at its current location, however there are opportunities to reduce the amount of fencing and other infrastructure around the well site. The irrigation pump could be moved, however it is likely cost prohibitive to do so. The inlet and outlet structures will have to be modified as part of any modification to the pond.

Maintenance Area
The existing maintenance buildings are sited at a very prominent location in the park. They are older utilitarian buildings that some citizens have referred to as an eyesore. There is an opportunity to relocate the maintenance area to a less prominent location that is better screened, fits into the context of the proposed park plan, and functions more efficiently.

Access

Bicycle/Pedestrian
A major regional trail is located along the east side of the site. This trail provides exceptional access to the park for cyclists and pedestrians throughout the Village. The trail system provides excellent connectivity to several parks and civic areas within the Village, and it provides easy access to the Cherry Creek Trail and the High Line Canal

Trail. Closer to the site, the loop trail provides access directly from the Cherry Creek Village North subdivision and the RTD light rail station.

Light Rail
A light rail station is located directly north of the site and is within easy walking distance of the park. The station is accessible by a pedestrian bridge that crosses over I-225.

Auto Parking
There is an existing parking lot at the north end of Village Greens South.

Property Issues

Cherry Creek Village
The Cherry Creek Village North subdivision is located directly west of the site. The rolling nature of the site may offer an opportunity to screen some uses from Cherry Creek Village North. Also, the site is large enough to provide a substantial buffer from the neighborhood.

U.S. Army Corps of Engineers (Corps)
A significant portion of the park site is owned by the Corps, and leased by the Village. The Corps will have to review and approve any proposed improvements on their property.

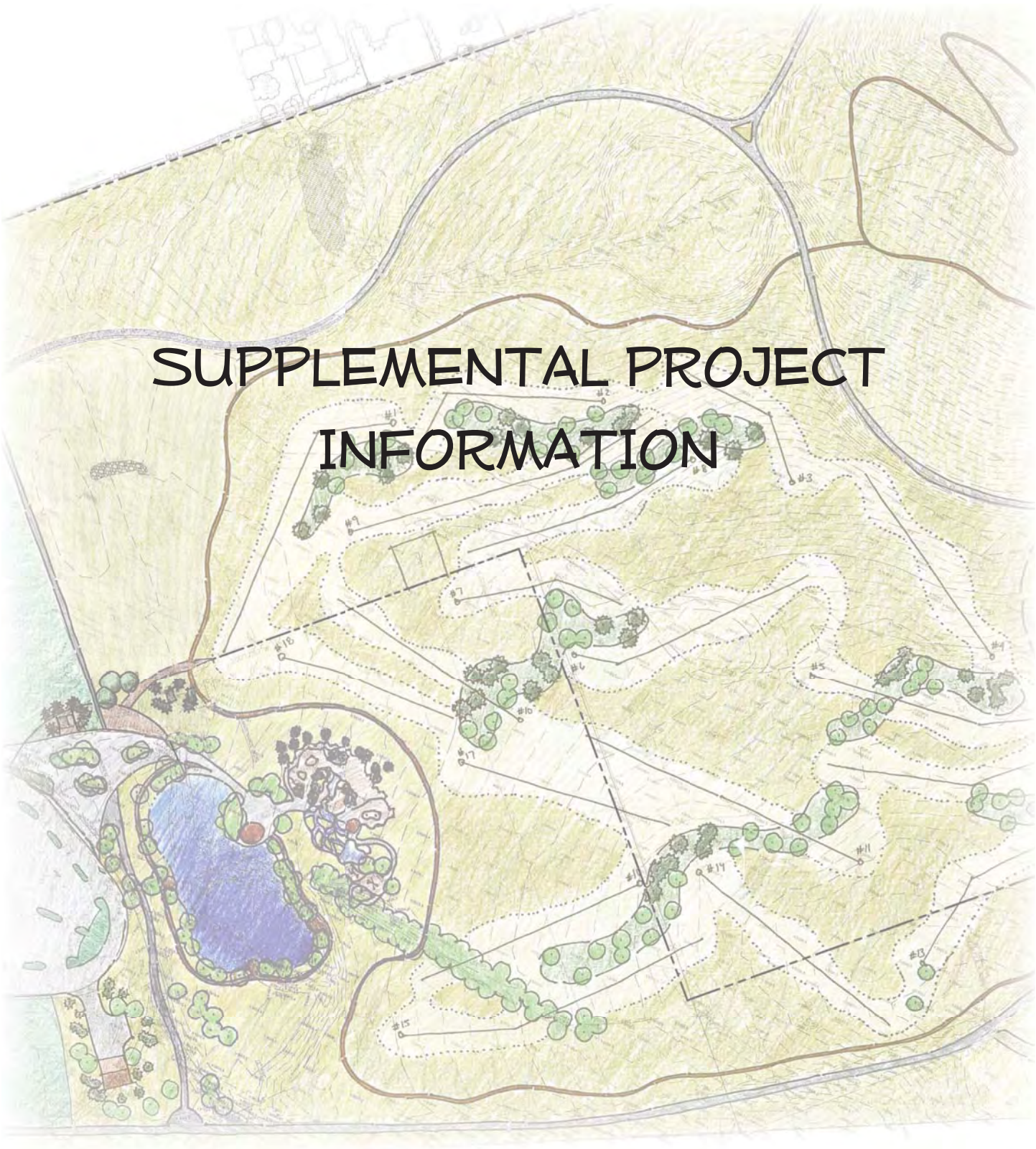
Natural Resource Issues

Wetlands
There are wetlands located at two locations on the site. One is the holding pond that the Village plans to renovate. It will be important for the Village to review any proposed wetlands impacts to determine if the wetlands are jurisdictional and may require specific permitting through the Corps of Engineers.

Black-tailed Prairie Dogs and Burrowing Owls
In 2006, The Village hired ERO Resources to prepare the Black-tailed Prairie Dog Management Plan. That plan discusses the presence of, and recommendations for, the prairie dog colony that is present on the site. The management plan also indicates that burrowing owls were nesting on the site at that time. Burrowing owls are protected by Federal and State laws including the Migratory Bird Treaty Act. Prior to implementing any improvements on site, the Village will have to determine if the owls are still nesting on the site. The presence of owls would require that the construction schedule be timed to begin after November 1st when the owls leave the state.

Other Wildlife

The site is frequented by other wildlife, including deer, coyotes, migratory birds, and other small and large animals.



SUPPLEMENTAL PROJECT INFORMATION

PRELIMINARY CONCEPT PLAN

VILLAGE GREENS NORTH
CITY OF GREENWOOD VILLAGE
JANUARY 7, 2010

Mountain Bike Skills Trail
total length approx. 2.67 miles

Existing Loop Trail

Re-align Loop Trail

Mountain Bike Skills Trail
Canyon Loop - approx. .9 miles

To Light Rail
Station

Tree Restoration
Area

Mountain Bike Skills Trail
Prairie Loop - approx. 1 mile

Ex.
Water
Quality
Basin

Restrooms

Booster
Pump

#16

#15

#14

#13

#12

#17

Overlook

Well

Shelter

Bouldering Area

New
Pond

Existing
Ballfields

Entry/
Drop off

Plaza/
Gathering
Area

#18

#10

#11

#9

#8

Prairie Dog Habitat
13.3 Acres

Existing Loop Trail

#6

Existing
Parking

#1

#7

Non-traditional
Play Area

#4

#2

#3

#5

Existing
Ballfields

Existing Wooded Drainage

Existing Regional Trail

Re-align Loop Trail

Mountain Bike Skills Trail
total length approx. 2.67 miles

Maintenance/Storage

Screening

New Drainages (Typ.)

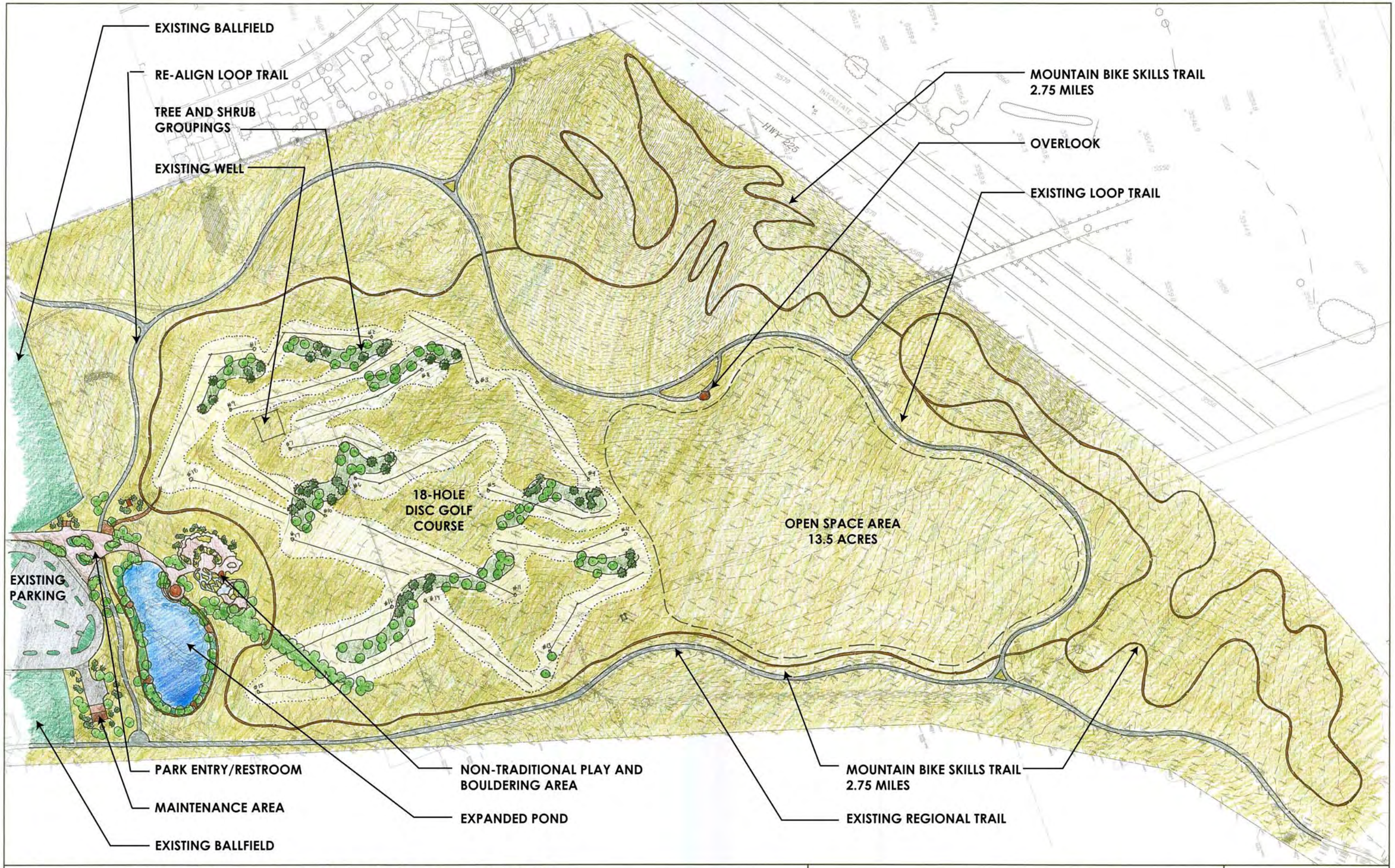
ARCHITERRA GROUP
5881 south deframe st.
littleton, colorado 80127
303.948.0766 fax.948.0977
www.architerragroup.com

GREENWOOD VILLAGE COLORADO

NORTH

0 50' 100' 200'

SCALE: 1"=100'



VILLAGE GREENS NORTH
PRELIMINARY MASTER PLAN

MAY 6, 2010

City of Greenwood Village
6060 South Quebec Street
Greenwood Village, CO 80111

ARCHITERRA GROUP
5881 south deframe street
littleton, colorado 80127
303.948.0766 fax.948.0977
www.architerragroup.com

NORTH

SCALE: 1"=100'

0 50' 100' 200'

Village Greens North
Public Meeting #1
January 7, 2010

A public meeting was held at the Cherry Creek Presbyterian Church. Debbie Belcik introduced Village staff, PTR commissioners, City Council members, and the consultant team that were present. She then presented a brief history of the site and goals for the project. Mark Taylor presented the Opportunities and Constraints Plan, and the Concept Plan.

The following are comments received during the public meeting:

- Several comments regarding interest in removing prairie dogs from the site due to concerns about disease, damage to infrastructure, and safety.
- One citizen expressed interest in trying to re-use or salvage portions of the maintenance storage buildings.
- Some discussion about disc golf – Some would like to see standard disc catchers used rather than natural targets like trees or boulders. They believe this would likely draw more disc golfers and may return better use for the investment.
- Several comments regarding the desire for picnic areas
- Some concern was expressed about user conflicts where the mountain bike trail crosses the paved multi-use trail.
- One citizen asked to have a crusher fines path along the entire existing loop trail so walkers and runners can stay off of the concrete.
- There was some discussion about the need for a skateboard park and basketball courts in the area. They asked the City to consider these uses in Village Greens North.
- Another citizen asked that we explore how nearby property values would be affected if a skatepark were installed at Village Greens.
- There was a request to study how much additional use/traffic the new park expansion may bring to the area.

Comments received from residents by phone regarding Public Meeting #1

Carmen Harrington, City of Greenwood Village

December

Jean Sidinger
Called to find out where VGN Park was located. I called back and left a message giving the address and major cross streets near the park. She did not return my call.

James Taylor
Called to say he could not attend the public meeting but would like to be kept informed as plans for the park develop. I explained the elements of the park.

January

Sonny Weber
1/7/10
Ms. Weber called to discuss the master plan for Village Greens North Park because she would be unable to attend the 1/7/10 public meeting. I described to her the main elements of the plan which would include a bouldering area, natural play area, disk golf course and a single track mountain bike loop.

Ms. Weber expressed her concern first for the prairie dogs on the site. She was concerned the prairie dogs would be exterminated with the development of the park. I informed Ms. Weber that the design for the park included a 13.3 acre area for prairie dogs to utilize. I also told her 13.3 acres would be adequate to support the current population of roughly 190 prairie dogs. Also, the prairie dogs would have to be moved to the north and the Village would make several attempts to move them utilizing passive relocation techniques. This answer seemed to be acceptable to Ms. Weber.

Ms. Weber then expressed her concern that the park would attract too many bicyclists. Ms. Weber relayed several instances when she had been walking with her dogs on the existing concrete trails and had conflicts with bicyclist. She expressed the need for signage to remind everyone of "trail etiquette". Ms. Weber also expressed her concern regarding mountain biking trails and the rutting they cause. I assured Ms. Weber I would bring her concerns to the design team and consider them carefully.

Mr. Kirby Cockerham
1/7/09
Mr. Cockerham called in regards to the notice for the public meeting he had received. He was particularly concerned about the use of xeric landscaping. He was concerned the use of xeric landscaping would be similar to desert plants and that the park would be brown in the spring and summer months and never green. I assured Mr. Cockerham that by xeric landscaping the Village did not mean cactus and rock but the Village intends to plant native grasses, trees, and shrubs that are indicative of our semi-arid climate. This would include native plant material that can be sustained with the current water resources. Mr. Cockerham seemed satisfied with this answer and was supportive of the improvements to VGN Park.

Judy Enderly of Broomfield
1/7/09
Ms. Enderly called to express her concern for the prairie dogs that currently inhabit VGN Park. She was concerned the development of the park would result in the extermination of the prairie dogs. I informed Ms. Enderly that the concept for the park included 13.3 acres for the prairie dogs to inhabit. I also informed her, the Village would begin moving the prairie dog population toward the north end of the site utilizing passive relocation techniques and there would be several attempts. I added that the Village intends to incorporate visual barriers to keep the prairie dog population in this area. Ms Enderly seemed satisfied with this answer. She suggested planting rabbit brush along the boarder to discourage the prairie dogs from expanded outside the 13.3 acre area.

Cathy Lindquist Klassen
1/11/10
Ms. Lindquist Klassen called to find out what features were planned for VGN Park. I explained that the features planned included a single track mountain bike loop, natural play ground, bouldering, and disk golf course. I also described where these features would be located. I added that 13.3 acres would be left for prairie dogs. She said she liked the prairie dogs and the other wild life they bring, hawks and coyotes. She did not have a major issue with any of the features but did ask that more screening via shrubs and trees be added behind the homes on the west. She also expressed interest in a street style skate park. She has a 15 year old son that skate boards. I told her the idea of a skate park was brought up at the January 7th public meeting. She was glad to hear this segment of the population was represented at the meeting.

Village Greens North
Public Meeting #2
March 2, 2011

A public meeting was held at City Hall. Debbie Belcik introduced Village staff, Council members, and the consultant team that were present. Debbie presented a brief project background. Mark Taylor presented a summary of the process to date. He then presented the preliminary master plan in detail, including estimates of probable construction costs and phasing options.

The following are comments received during the public meeting:

- What is Frisbee golf and who plays it?
- What age, demographics are we designing for or want to attract to the park?
- Comment that there may be conflict between bike, car, pedestrian at the new entrance of the park
- Question regarding the potential liability due the height of climbing structures. Park may not have adults supervising children like at Westland Park.
- Question about the lifespan of the rubberized surfaces proposed in the play area
- Can pedestrians use the mountain bike trials?
- Concern that the amenities, particularly the disc golf course, will present a visual east/west impact in the undeveloped open space
- Concern that the disc golf course will create noise
- Questions about keeping the park for GV residents only
- There was a comment about the mowing in the park property by homeowners directly adjacent to the park.
- Some residents would like the option to select how much vegetation is installed along the border to their property.
- Add wildflowers to the park's vegetation
- Questions about the aquifer, depth of well, etc.
- Concern about parking by park users along Alton—develop a plan to address this
- Concern about activity in the park after dark. Residents were encouraged to call police. Discussion about courtesy patrols in the park
- Questions about park maintenance costs and depreciation
- Concern about wildlife being impacted by the park, specifically the prairie dogs and the coyotes living in the drainage area with trees
- Comments made about possible cross country skiing on mountain bike trails in the winter
- Comments made about the speed of bikes, especially road bikes on existing paved trails
- Comment made that the park is the best low-impact design they have seen over the years for this acreage.
- Concern that there will be maintenance of the area once built. Staff shared that this would become a park maintenance responsibility as well as users "owning' the park
- Concern for the habitat protection
- Several individuals want the park design presentation to share with neighbors
- Comment about a park design being low impact and not requiring a lot of water—good design.
- Request to move the disc golf course to the east further away from homes

- Cost, where is the money coming from to pay for the park?
- It is important to keep the existing tree located north of the existing ballfields, and southwest of the well.
- In the winter, kids use the berms near I-225 for sledding.
- Don’t see a need to re-align the existing paved loop trail north of the ballfields.
- Comments were overall in support of the park design

GREENWOOD VILLAGE
MEMORANDUM

DATE: August 17, 2010

TO: Fred Rios, US Army Corps of Engineers; Ben Letak, US Army of Engineers

FROM: Carmen Harrington, Project Manager

SUBJECT: Village Greens North: Irrigation Pond Leakage Detection and Monitoring

The City of Greenwood Village (the City) is proposing to develop land located in an area between the Cherry Creek Dam and Interstate 25, known as Village Greens North. The City leases a portion of this land from the Corps, see Attachment 1.

The project goal is to design passive park amenities, utilizing xeriscape gardens and natural park area and non-traditional adventure play features based on the public input process, see Attachment 2. The project will also improve the aesthetics of both the existing irrigation pond and the storage sheds. After meeting with the Corps, the City was tasked with addressing possible leaks from the proposed expanded irrigation pond would be monitored and detected. The City has developed the following plan.

The existing irrigation pond has an approximate surface area of 10,313 square feet. The City proposes excavating and expanded the existing irrigation pond to have an approximate surface area of 34,750 square feet and a maximum depth of 15 feet, see Attachment 3. A clay liner will be constructed to minimize the pond's water loss. Specifications for the clay liner can be found in Attachment 4. After the pond is constructed a Water Level Control Structure will be installed to monitor changes in the water surface, see Attachment 5. Water from the pond is used to irrigate the nearby athletic fields Monday through Wednesday from April to October. Therefore, water will not be drawn from the pond Thursday to Friday. The pond will be supplied with water from two sources, the well and the municipal water tap. Floats will be attached to both these sources to automatically supply the pond with water to replace the water used for irrigation. The City will place meters on both these sources. To monitor water loss the City will take readings of the water level and both water source meters on Friday mornings and then again on Monday mornings. The City will calculate water loss due to evaporation and water gained from precipitation to determine net loss/gain from the pond, see Attachment 6. These readings and calculations will be carried out year round. These readings and calculations will be shared with the Corps.

VILLAGE GREENS NORTH

Attachment 1: Proposed Master Plan

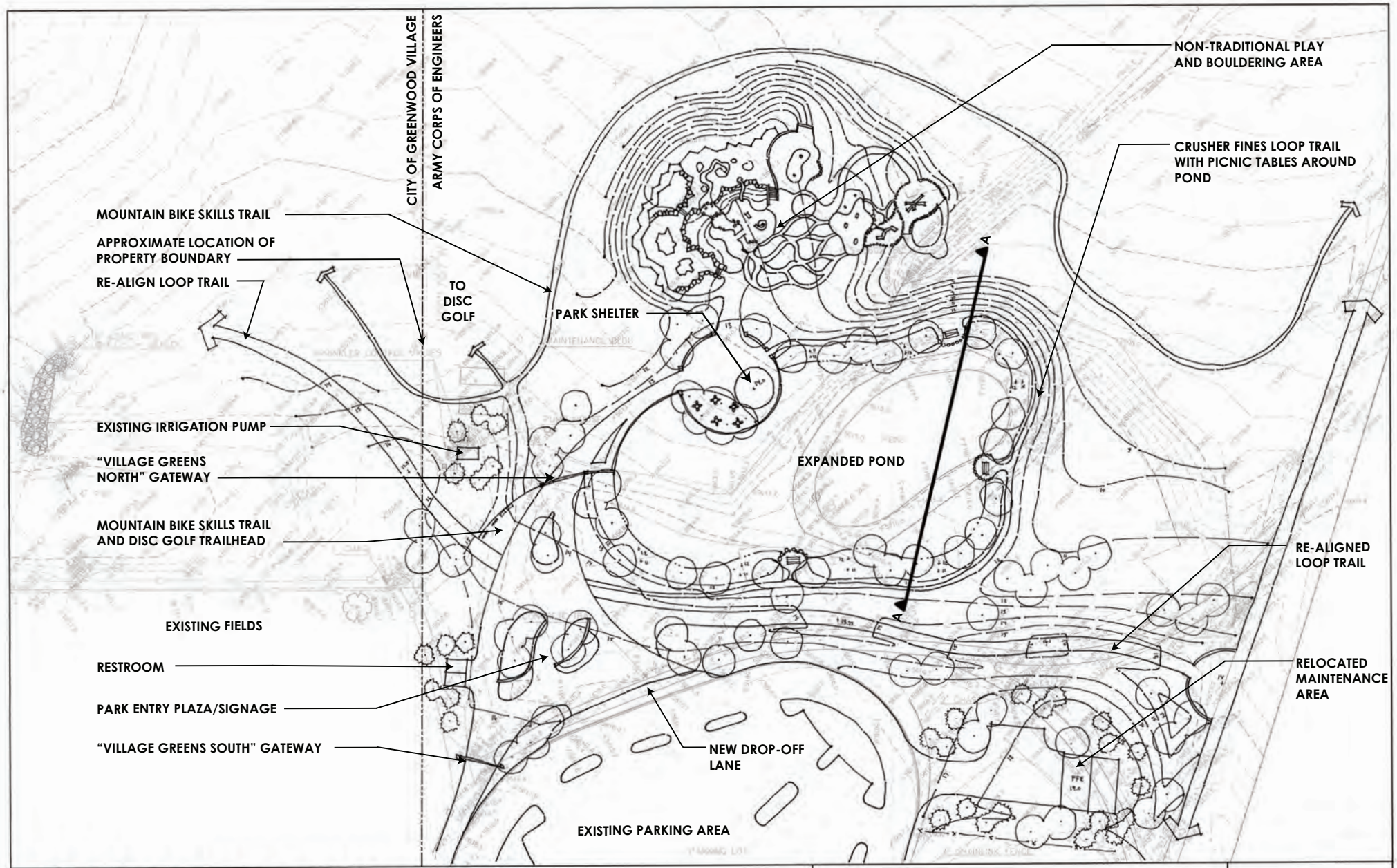
MAY 28, 2010

City of Greenwood Village
6060 South Quebec Street
Greenwood Village, CO 80111

ARCHITERRA GROUP
5881 south deframe street
littleton, colorado 80127
303.948.0766 fax.948.0977
www.architerragroup.com

NORTH

0 50' 100' 200'
SCALE: 1"=100'



VILLAGE GREENS NORTH

Attachment 2: Proposed Park Features

AUGUST 13, 2010

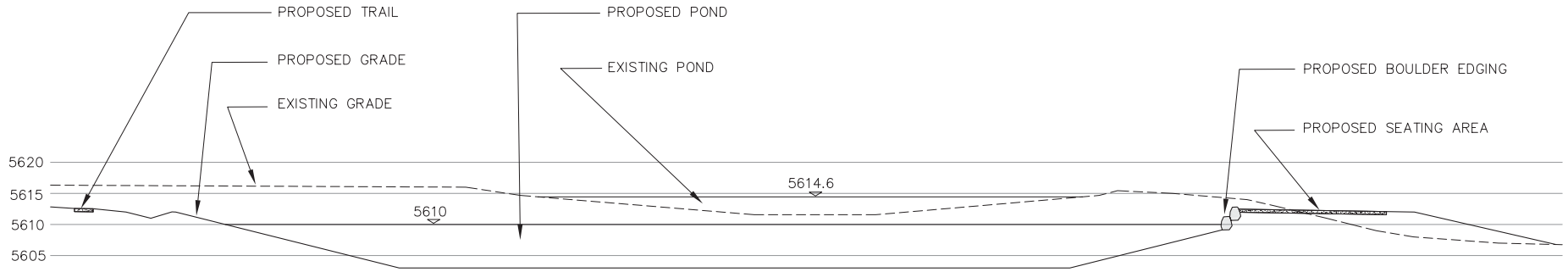
City of Greenwood Village
6060 South Quebec Street
Greenwood Village, CO 80111

ARCHITERRA GROUP
5881 south deframe street
littleton, colorado 80127
303.948.0766 fax.948.0977
www.architerragroup.com

NORTH

SCALE: 1"=30'

0 15' 30' 60'



SECTION A–A'

VILLAGE GREENS NORTH

Attachment 3: Pond Section

City of Greenwood Village
6060 South Quebec Street
Greenwood Village, CO 80111

ARCHITERRA GROUP
5881 south deframe street
littleton, colorado 80127
303.948.0766 fax.948.0977
www.architerragroup.com

0 4' 8' 16'
SCALE: 1/8"=1'-0"

Attachment 4: Clay Pond Liner Specifications

PART 1 - GENERAL

1.01 DESCRIPTION
Under these specifications, the contractor shall furnish all labor, material, and tools required for the complete installation of an impermeable storage pond liner as hereinafter described.

1.02 QUALITY ASSURANCE
The Contractor shall complete the work in accordance with the following standards.
ASTM:
A-564, D-1505, D-413, D-1557, D-638, D-1593, D-746, D-1603, D-751, D-1693, D-1004, D-2136, D-1149, D-3083, D-1203, FTSM-101B, D-1204

1.03 SUBMITTALS
The contractor shall submit for EMWD approval clay samples and samples of any material not specifically noted in the specifications. Laboratory tests shall accompany any clay sample indicating conformance to the specifications.

1.04 PRODUCT DELIVERY AND STORAGE
During transit and storage, all applicable rules and regulations must be followed. Jobsite storage and handling shall not create a nuisance nor damage the lining materials.

1.05 WARRANTY
The Contractor shall guarantee the entire work constructed by him under the Contract to be free of defects in materials and workmanship for a period of two (2) years following the date of probationary acceptance from the City. The Contractor shall agree to make, at his own expense, any repairs or replacements made necessary by defects in materials or workmanship in the work which become evident within said guarantee period. The Contractor shall make repairs and replacements promptly upon receipt of written order from the City. If the Contractor fails to make the repairs and replacements promptly, the City may do so, and the Contractor shall be liable to the City for the cost of such repairs and replacements.

1.06 EXPERIENCE OF CONTRACTOR
The Contractor installing the clay liner shall have demonstrated his ability to perform this work by having previously successfully installed, in hydraulic structures, a minimum of 1,000,000 square feet of similar type.

PART 2 - PRODUCTS

2.01 MATERIALS
A. The clay used for the liner shall have the following properties:
1. Unified Soil Classification "CL".

2. Liquid limit between 25 and 40.
3. Plasticity Index between 20 and 30.
4. Impervious to flow of water when a 12" thick layer is compacted to 90% relative compaction per ASTM D-1557.

2.02 MIXES

A. Areas dominated by coarse grained materials and lacking sufficient amounts of clay to prevent seepage can be sealed by adding material containing at least 20% clay.

PART 3 - EXECUTION

3.01 INSPECTION

A. Pre-construction Inspection. The Contractor shall inspect the excavated basin prior to bidding. Any access problems, sub-grade problems, any structures at pipe penetrations, or other problems that may interfere with or affect the performance of the clay liner shall be addressed by the contractor and submitted for approval prior to installation.

B. Clay shall be continuously inspected by the City's designated representative during placement.

C. All surfaces to be lined with clay shall have all points projecting above Sub-grade removed and the surface shall be rolled or otherwise compacted to 90% relative compaction prior to placement of clay.

3.02 INSTALLATION

A. SUB-GRADE

1. Scarify the soil (see Grading Practices BMP) to a depth of 8-10 inches with a disk, roto-tiller, pulverizer, or similar equipment. Remove all rocks and tree roots.
2. Under optimum moisture conditions, roll the soil under to a tight layer making 4-6 passes with a sheepsfoot roller to compact the soil. The soil should be compacted to a minimum of 8 inches for impoundments up to 10 feet in depth. In cases where the depth of the water will exceed 10 feet, remove the top layers of soil and compact the bottom two or more layers. Each layer should be no more than 8 inches thick. Once the bottom layers are compacted, replace the topsoil and compact it like the other layer(s).
3. The surface of earth sub-grade shall be maintained in a smooth, uniform and compacted condition during installation of the lining. Excessive cracking of the surface shall be repaired as directed by the District. The lining contractor shall be responsible for, and pay for, any necessary repairs to the earth sub-grade required as a result of operations of lining installation.
4. Before final rolling and compaction, the earth sub-grade shall be free from abrupt breaks, rocks, cobbles, boulders, debris and other foreign materials. Final rolling and compaction of the surface of earth sub-grade shall be done with a vibrating roller or a steel wheel roller weighing not less than 200 pounds per linear inch of drum width. The surface shall be compacted to a minimum relative compaction of 90%. Areas not accessible to the roller shall be compacted by approved mechanical or hand tampers.

5. The surface of the sub-grade shall be smooth, uniform and free from sudden changes in grade. Minimum acceptable radius at corners shall be 25 feet.

B. CLAY LINER

1. The clay material should be a minimum of 18 inches thick for all depths of water.
2. The clay shall be compacted to a minimum of 90 percent relative compaction per ASTM D-155
3. If draw-down will occur, cover the clay in those areas with 12-18 inches of gravel to protect it from cracking.
4. The placement, water content, compaction and densities of placed clay must be supervised and approved by the City's designated representative.

Attachment 5: Water Level Control Structure

Thursday July 17th 2008

Valves & Gates
Check Valves
Slide Gates Valves
Flap Gates
Inline Water Level Control Structure
Inlet Water Level Control Structure
Large Diameter Water Level Control Structure

Installation Instructions (PDF Format)

Inlet Water Lvl Control Structure

Agri Drain CORPORATION Inlet Water Level Control Structure™

- Rugged 1/2" PVC structure.
- Stainless steel screws and custom anodized aluminum corner extrusions are used for strength and durability.
- 5" & 7" stoplogs for adjustability.
- Flexible couplers allow PVC, plastic pipe, or other materials to be easily attached. *(Please specify type of pipe when ordering)*
- 5-Year Warranty on all parts
- Please allow up to 2 weeks for shipment.

Flexible rubber connectors with heavy duty stainless steel clamps.

5" x 7" stoplogs for adjustability. Durable stainless steel lifting hooks.

Hours:
Mon-Fri 7am-5pm cst

Location:
1462 340th St.
Adair, IA 50002

Phone:
1-800-232-4742
1-641-742-5211

Fax:
1-800-282-3353
1-641-742-5222

Email:
info@agridrain.com

more info

Item#	Description	List Price
INLET02X04P	Inlet WCS 2'x4" PVC	$289.00
INLET02X06P	Inlet WCS 2'x6" PVC	$293.00
INLET02X08P	Inlet WCS 2'x8" PVC	$302.00
INLET02X10P	Inlet WCS 2'x10" PVC	$338.00
INLET02X12P	Inlet WCS 2'x12" PVC	$368.00
INLET02X15P	Inlet WCS 2'x15" PVC	$400.00
INLET02X18P	Inlet WCS 2'x18" PVC	$494.00
INLET03X04P	Inlet WCS 3'x4" PVC	$327.00
INLET03X06P	Inlet WCS 3'x6" PVC	$331.00
INLET03X08P	Inlet WCS 3'x8" PVC	$347.00
INLET03X10P	Inlet WCS 3'x10" PVC	$390.00
INLET03X12P	Inlet WCS 3'x12" PVC	$421.00
INLET03X15P	Inlet WCS 3'x15" PVC	$474.00
INLET03X18P	Inlet WCS 3'x18" PVC	$574.00

Attachment 6: Net Water Loss/Gain

Table 1
Net Evaporation Summary
Greenwood Village, CO

Month	Average Temperature (°F) [1]	Gross Evaporation (ft) [2]	Total Precipitation (ft) [3]	Effective Precipitation (ft) [4]	Net Evaporation (ft) [5]
Jan	28.2	0.11	0.04	0.03	0.08
Feb	30.3	0.13	0.04	0.03	0.10
Mar	34.3	0.20	0.09	0.06	0.14
Apr	45.1	0.32	0.15	0.11	0.21
May	53.1	0.43	0.21	0.15	0.28
Jun	64.8	0.52	0.17	0.12	0.40
Jul	69.6	0.54	0.19	0.13	0.41
Aug	67.6	0.48	0.15	0.11	0.37
Sep	58.3	0.36	0.10	0.07	0.29
Oct	48.1	0.25	0.08	0.06	0.19
Nov	35.7	0.14	0.08	0.06	0.08
Dec	29.1	0.11	0.04	0.03	0.08
Annual		3.59	1.34	0.96	2.63

Notes:

[1] Average temperatures obtained from CDSS for the NOAA Cherry Creek Dam Climate Station (Station ID 1547).

[2] Gross evaporation equals 43.0 inches per year. Data based upon NOAA Technical Report NWS 33 (Evaporation Atlas for the 48 Contiguous US, 1982), distributed monthly based upon the State's guidelines for SB-120, for a pond elevation of 5700 feet.

[3] Total precipitation obtained from CDSS for the NOAA Cherry Creek Dam Climate Station (Station ID 1547).

[4] Effective precipitation equals 70 percent of total precipitation.

[5] Net Evaporation equals gross evaporation less effective precipitation, [2] - [4], if greater than zero, else zero.

Temperature and Precipitation data based upon average monthly data for the NOAA Cherry Creek Dam Climate Station (Station ID 1547)

Table 2
Total Evaporation Summary
Greenwood Village, CO

Month	Average Temperature (°F) [1]	Gross Evaporation (ft) [2]	Total Precipitation (ft) [3]	Effective Precipitation (ft) [4]	Net Evaporation (ft) [5]
Jan	28.2	0.11	0.04	0.04	0.07
Feb	30.3	0.13	0.04	0.04	0.09
Mar	34.3	0.20	0.09	0.09	0.11
Apr	45.1	0.32	0.15	0.15	0.17
May	53.1	0.43	0.21	0.21	0.22
Jun	64.8	0.52	0.17	0.17	0.35
Jul	69.6	0.54	0.19	0.19	0.35
Aug	67.6	0.48	0.15	0.15	0.33
Sep	58.3	0.36	0.10	0.10	0.26
Oct	48.1	0.25	0.08	0.08	0.17
Nov	35.7	0.14	0.08	0.08	0.06
Dec	29.1	0.11	0.04	0.04	0.07
Annual		3.59	1.34	1.34	2.25

Notes:

[1] Average temperatures obtained from CDSS for the NOAA Cherry Creek Dam Climate Station (Station ID 1547).

[2] Gross evaporation equals 43.0 inches per year. Data based upon NOAA Technical Report NWS 33 (Evaporation Atlas for the 48 Contiguous US, 1982), distributed monthly based upon the State's guidelines for SB-120, for a pond elevation of 5700 feet.

[3] Total precipitation obtained from CDSS for the NOAA Cherry Creek Dam Climate Station (Station ID 1547).

[4] Effective precipitation equals 100 percent of total precipitation for this scenario, which represents total evaporation minus total precipitation.

[5] Net Evaporation equals gross evaporation less effective precipitation, [2] - [4], if greater than zero, else zero.

Temperature and Precipitation data based upon average monthly data for the NOAA Cherry Creek Dam Climate Station (Station ID 1547

Geotechnical/Dam Safety Review Information & Comments for

Irrigation Pond Leakage Detection and Monitoring Plan - Village Greens North Park
Cherry Creek Dam, Arapahoe, Colorado

By
Benjamin J. Letak, P.E/David F. Sobczyk, P.E., Dam Safety Program Manager
6 December 2010

1. General Information/Review History. The City of Greenwood Village has proposed to develop an area of land between Cherry Creek Dam and Interstate 225 for recreational purposes. This area, Village Greens North, is 80 acres in size and is due north of an existing 40-acre recreation area that includes baseball, softball and soccer fields and 2 parking lots (Village Greens Park). The eastern edge of the proposed development is 100 to 200 feet downstream of the downstream toe of Cherry Creek Dam on the left (west) abutment between embankment stations 21+00 and 51+00.

The Village Greens North development plan includes a 2.75 mile mountain bike skills trail, an 18-hole disc golf course, a non-traditional play and bouldering area, a 13.5-acre open space area, public restrooms, a relocated maintenance area and the expansion of an existing irrigation pond from 10,300 sq feet to 34,800 sq. feet. The western 2/3rd of the area (about 50 acres) is owned by the City of Greenwood Village. The eastern 1/3rd (about 30 acres) is USACE-owned land adjacent to Cherry Creek Dam and includes the proposed pond expansion area.

Since January 2010, 3 submittals have been provided to Geotechnical Engineering and Sciences Branch for review:

1.1. Preliminary Concept Plan (1 drawing), dated 1/7/10, received 1/28/10. Preliminary e-mail comments were provided to the City of Greenwood Village on 2/2/10.

1.2. Preliminary Master Plan (1 drawing), dated 5/6/10, received 5/14/10. A coordination meeting with USACE and the City of Greenwood Village was held 7/8/10 at Chatfield Dam to discuss USACE concerns with the plan. Also discussed were current USACE plans to improve surface drainage in the area as part of the Relief Well and Toe Drain Collector Pipe Rehabilitation contract.

1.3. Irrigation Pond Leakage Detection and Monitoring Plan Memorandum and Attachments (6), dated 8/17/10. Review of this plan as well as a general review of the overall development plan is provided below.

2. Irrigation Pond Leakage Detection and Monitoring Plan Review.

2.1. General Observations & Review Information:

2.1.1. The eastern edge of the existing irrigation pond is 260 feet from the downstream toe of Cherry Creek Dam. The western edge of the existing pond is 425 feet from the toe. The eastern edge of the proposed pond expansion remains 260 feet from the downstream toe. The western edge of the proposed pond expansion is 560 feet from the toe, 135 feet west of the existing pond's western edge.

2.1.2. The vertical datum used in the submittal is NGVD 1929 (per 10/14/10 Carmen Harrington email). Based on September 2010 USACE surveys, NGVD 1929 is about 1.3' below Cherry Creek Dam's "Local Project Datum", and 3.0' below NAVD 1988 in the Cherry Creek Dam area.

2.1.3. According to the Pond Section submitted (Attachment 3); the water level of the proposed pond expansion will be El. 5610.0 (NGVD 29). The bottom of the proposed pond expansion will be about El. 5603 (NGVD 29). The water depth of the proposed pond expansion will be about 7 feet.

The water level in the existing pond is at El. 5614.6 (NGVD 29). The bottom of the existing pond is at about El. 5612 (NGVD 29). The existing pond appears to be filled with several feet of sediment.

The bottom of the proposed pond expansion appears to be 7 to 9 feet below the bottom of the existing pond. The water level of the proposed pond expansion is about 5 feet below the water level of the existing pond.

2.1.4. The grading shown on the Proposed Park Features drawing for the pond expansion (Attachment 2) was reviewed and compared to (1) the existing topography in the area; (2) the original topography when Cherry Creek Dam was constructed (1940's); and (3) bedrock maps for the area (1940's). The following was determined:

2.1.4.1. The grade of the existing irrigation pond compared to the original topography indicates the existing pond area was constructed mostly with fill. It appears that minimal or no excavation was performed below original topography to construct this existing pond.

2.1.4.2. The proposed grade of the new pond expansion compared to the existing and original topography indicates that construction of the new pond will require removal of some of the existing pond fill and excavation of up to 6 feet into native material below the original topography. The western 2/3rd of the bottom of the proposed pond expansion is at or below the original topography (i.e., it will require excavation into native materials). The eastern 1/3rd of the new pond bottom is above the original topography, suggesting that existing fill materials will exposed at the floor subgrade.

2.1.4.3. The top of the weathered Denver Formation bedrock in the area of the proposed pond expansion is about El. 5615 to El. 5620 (NGVD 29). It anticipated that most, if not all, excavation required on the west side of the proposed pond (up to 6 feet) would occur in the Denver Formation bedrock.

2.1.5. As-built cross-sections of Cherry Creek Dam at Stations 20+00 and 27+00 [immediately upstream (east) of the proposed pond expansion area] were reviewed and indicate that the base of the dam sits on 5 to 10 feet of overburden (silty loam to lean clay) on top of the weathered Denver Formation bedrock in this area. The base width of the dam is 150 to 250 feet. The impervious cutoff trench below the dam extends through the overburden soils from Station 45+00 on the west side of the dam to Station 135+00 on the east side. However, no cutoff exists in the proposed pond expansion area. The Denver Formation bedrock is considered impervious from an underseepage standpoint. The potential underseepage path under the dam in the pond expansion area is through the overburden soils. This path is long and narrow (5 to 10 feet in thickness over a distance of 150 to 250 feet).

2.2. <u>Review Comments:</u>

2.2.1. Based on the observations and information discussed above, the configuration and grading of the proposed pond expansion is acceptable provided USACE concerns relating to pond leakage and monitoring are addressed (see comments 2.2.4. & 2.2.5. below).

2.2.2. There are no concerns related to underseepage beneath Cherry Creek Dam resulting from the proposed pond expansion.

2.2.3. The proposed pond expansion is 260 feet from the downstream toe of Cherry Creek Dam. It appears there is (would be) enough of a buffer along the toe of the dam for possible future dam safety needs (e.g. access for flood fighting during high pools and inspection/maintenance reasons; construction of remedial seepage control measures; relocation of the Dam Road to the toe of the dam; raising the dam on the downstream side; etc).

2.2.4. As discussed the during the 7/8/10 coordination meeting, a significant USACE concern is the potential for leakage from the proposed pond expansion and its impact to existing surface drainage problems and groundwater levels along the toe of the dam. Leakage from the expanded pond could hinder visual surveillance of the dam during a high pool event.

The submittal package indicates that an 18-inch clay-only liner will be constructed to minimize water loss from the pond. The clay pond liner specification states that if drawdown occurs, the clay in those areas exposed will be covered with 12 to 18 inches of gravel to protect it from cracking.

USACE has concerns with the long term effectiveness of the 18-inch clay-only liner in preventing leakage. The clay liner may not provide adequate protection due to desiccation and freeze/thaw effects. The liner design should include a flexible geomembrane and protective cover soil. A properly anchored geomembrane (e.g. a 40mil HDPE) and an 18-inch permanent protective cover layer should be added above the clay liner to minimize the potential for leakage.

2.2.5. Despite efforts to minimize or eliminate pond leakage, there is still a possibility that pond leakage may occur. USACE recommends that a minimum of three shallow open-tube piezometers be placed strategically on the north and east sides of the proposed pond expansion to monitor for leakage. Based on a cursory review of subsurface conditions in the area, it appears that the piezometers would be 10 to 20 feet deep. USACE can assist with determining the optimum location and design for these piezometers. The piezometers should be installed prior to pond construction to help determine baseline groundwater conditions. USACE would monitor the piezometers in conjunction with other existing piezometers in the area.

2.2.6. A detailed plan of operation for the pond expansion and its water sources (well and municipal water tap) should be submitted for review. USACE has several comments/questions regarding the plan of operation as presented. The submittal package includes a specification sheet for a Water Level Control Structure (attachment 5) and a statement that a staff gage would be installed to monitor changes in water level. There is also discussion of the planned daily operation of the pond from April to October. The operation plan should address the comments discussed below in addition to what has already been discussed or submitted previously.

2.2.6.1. The Pond Section submitted (Attachment 3), indicates the water level of the proposed pond expansion will be El. 5610.0 (NGVD 29). It not clear whether or not this is the maximum operating level or normal water level. The plan should address minimum, maximum & normal operating levels.

2.2.6.2. The submittal suggests that there will be floats attached to the water sources for the expanded pond. It does not mention whether or not there will be backups or redundancy incorporated into the design of the floats in case they fail. Backups or redundancy should be included in the design of these systems.

2.2.6.3. It's not clear how it is intended to operate the pond over the winter months (November to March). Will it be drained, maintained at an elevation, or allowed to evaporate?

2.2.6.4. It's not clear whether or not regular discharge or overflow from the pond to the drainageway is planned. USACE will not allow this. The drainageway below the existing pond already has surface water runoff problems that USACE is trying to correct. The only discharge that might be acceptable would be discharge to lower the pond for maintenance reasons, subject to prior approval by USACE.

2.2.6.5. It's not clear whether or not it's planned to monitor or document the operation of the water sources (well and municipal water tap). USACE is interested in the daily pumping/flow rates of the water sources and the duration of pumping/flow. It is requested that daily records be kept and provided to USACE on a regular basis (e.g. quarterly or yearly).

2.2.7. USACE reserves the right to dewater the pond if leakage is detected or suspected. This should be written into the legal agreement that covers this development (either the lease agreement or a memorandum of understanding).

3. <u>Overall Village Greens North Development Review Comments.</u>

3.1. Plans and specifications for this development should be submitted to the USACE for review and approval. All comments discussed in this review document should be addressed. Submittals will be vetted through USACE Omaha District's Engineering Division, Dam Safety Program Manager, and Dam Safety Committee for approval. A minimum of 60 days should be allowed for review of any submitted documents. The following plans, as well as responses to the specific comments below, should be included as part of future submittals for the development:

3.1.1. Grading Plan. USACE prefers minimal earthwork disturbance in the area proposed for development. No significant excavation will be allowed. Filling is acceptable, provided it does not create new drainage problems or make existing drainage problems any worse.

3.1.2. Drainage Plan. As mentioned previously in email comments and during the 7/8/10 coordination meeting, there are existing surface drainage problems near the toe of Cherry Creek Dam. USACE has recently awarded a contract to repair some of these problems during the next year. When considering the drainage design for the development area, surface runoff should be routed away from the downstream toe area of the dam as much as practical.

3.1.3. Irrigation Plan. Based on discussions during the 7/8/10 coordination meeting, it is understood that the development area will be managed as a dry land area. No irrigation is planned, other than drip irrigation for a number of trees to be placed in the disc golf area. This is acceptable.

3.1.4. Landscape Planting and Vegetation Plan. The Proposed Master Plan drawing (attachment 1) shows sporadic tree planting in the 18-hole disc golf course area. The closest trees in this area appear to be about 200 feet from the toe of the dam. These tree plantings would be acceptable. The Master Plan drawing shows a linear cluster of trees in the drainage ditch downstream of the expanded pond. It's not clear if the trees are meant to be existing or will be planted as part of the project. No new trees will be allowed in this area as part of this project. This is due to USACE's desire to be able to visibly detect any leakage from the pond. The Master Plan drawing shows a cluster of trees surrounding the proposed maintenance area southeast of the proposed pond expansion. Some of these trees appear to be within 100 feet of the dam toe. No trees shall be placed within 100 feet of the dam toe. If the intent of these trees is to block the view of this maintenance area, USACE would prefer fencing instead of trees.

3.1.5. Utility Plan. All below and above ground utilities planned for this development should be submitted for review. This should include power, gas, pipe for the well, pond, irrigation systems, etc. Any pressurized piping or water distribution and irrigation pipes that come within 250 to 300 feet of the downstream toe of the dam should be in compliance with USACE regulation NWDR 1110-1-1, Pressurized Waterlines in Existing Dam Embankments, dated 15 May 1999. A copy of this regulation is available upon request.

3.1.6. Building Plan. The Master Plan and Proposed Park Features drawings shows what appears to be a new building in the relocated maintenance area. It appears this building is about 140 feet away from the toe of the dam. No details have been provided for this building. USACE has concerns about any permanent structure being constructed this close the dam. A buffer needs to be maintained along the toe of the dam for possible future dam safety work. USACE prefers that any building in this area have minimal or no foundation with no basement (e.g. slab on grade-type construction) would be acceptable.

3.2. USACE has several dam safety instruments in the area of the development. These include, but are not limited to; a survey control monument (CP #5) on the eastern side of proposed the Open Space Area and a strong motion (seismic) instrument (already pointed out on the Plan). There may also be several property boundary markers in the area.

All dam safety instrumentation should be identified and protected from planned construction or other activities in the development area. Any damage to instrumentation caused by these activities should be

repaired. All dam safety instruments should be included on construction plans so that USACE and the construction contractor know where it is in relation to construction activities and can avoid it. The construction specifications should require that any damage to the instruments be repaired by the contractor at his expense to the satisfaction of the government. Any damage or disturbance of these instruments shall be reported to the government. The contractor should maintain a standoff distance of 50 feet from heavy equipment. Access to these instruments should not be blocked.

3.3. The legal document that covers this development (either the lease agreement or a memorandum of understanding), should include provisions that allows USACE the right to access the area to respond to dam safety emergencies.

3.4. A complete set of as-built plans for this project should be provided to USACE following the completion of work.

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littleton, colorado 80127
303.948.0766 fax.948.0977
www.architerragroup.com

Village Greens North Master Plan
City of Greenwood Village
Preliminary Estimate of Probable Construction Costs
May 23, 2011

Phase 1 - Relocate Maintenance Area				
ITEM	**UNIT**	**QTY**	**UNIT COST**	**TOTAL COST**
Mobilization	LS	1	$12,500.00	$12,500.00
Construction surveying	LS	1	$2,500.00	$2,500.00
Traffic control	LS	1	$5,000.00	$5,000.00
Site preparation and demolition	LS	1	$25,000.00	$25,000.00
Earthwork	LS	1	$15,000.00	$15,000.00
Water, sediment, and erosion control	LS	1	$7,500.00	$7,500.00
Water quality/detention structures	LS	1	$7,500.00	$7,500.00
Asphalt pavement (maintenance driveway)	SY	560	$35.00	$19,600.00
Maintenance building	LS	1	$65,000.00	$65,000.00
Soil preparation	SF	60,000	$0.25	$15,000.00
Dryland seed and mulch	SF	60,000	$0.07	$4,200.00
Shade trees	EA	10	$500.00	$5,000.00
Evergreen trees	EA	18	$400.00	$7,200.00
Irrigation system (drip system for tree establishment)	LS	1	$2,500.00	$2,500.00
Irrigation system (for seed establishment)	LS	1	$22,500.00	$22,500.00
Concrete pavement	SF	2,000	$5.00	$10,000.00
Copper water service line (to maintenance bldg)	LF	575	$17.50	$10,062.50
Electric service (to maintenance bldg)	LS	1	$12,500.00	$12,500.00
Subtotal Phase 1				$248,562.50
Design (Approximately 15%)				$37,437.50
Total Phase 1				**$286,000.00**

Assumptions:

Earthwork assumes all cut will be used as fill on site.

Assumes no new water taps will be required. Potable water service will be connected at the existing maintenance facility location.

Electric system includes power for lights and outlets at maintenance facility. Assumes electrical service will be connected at existing maintenance facility location.

Phase 2 - Mountain Bike and Disc Golf Course				
Mobilization	LS	1	$20,000.00	$20,000.00
Traffic control	LS	1	$2,500.00	$2,500.00
Site preparation and demolition	LS	1	$7,500.00	$7,500.00
Water, sediment, and erosion control	LS	1	$7,500.00	$7,500.00
Soil preparation	SF	375,000	$0.12	$45,000.00
Dryland seed and mulch	SF	375,000	$0.05	$18,750.00
Erosion control fabric	SF	17,500	$0.50	$8,750.00
Mountain bike trail (single track, dirt surface)	LF	14,615	$6.00	$87,690.00
Mountain bike skills obstacles (logs, rocks, water bars, etc)	LS	1	$80,000.00	$80,000.00
Disc golf baskets	EA	18	$700.00	$12,600.00
Colored concrete disc golf tee pads (12'x6')	SF	1,296	$10.00	$12,960.00
Disc golf signage	LS	1	$6,000.00	$6,000.00
Disc golf trail (single track, dirt surface)	LF	7,828	$6.00	$46,968.00
Mulch pads around baskets (30' diameter)	CY	160	$60.00	$9,600.00
Shade trees (disc golf course)	EA	65	$500.00	$32,500.00
Evergreen trees (disc golf course)	EA	43	$400.00	$17,200.00
Shrubs (disc golf course)	LS	1	$25,000.00	$25,000.00
Drip irrigation (disc golf course)	LS	1	$25,000.00	$25,000.00
Subtotal Phase 2				$465,518.00
Design (Approximately 15%)				$69,482.00
Total Phase 2				**$535,000.00**

Assumptions:

Assumes continuous silt fence will not be required along entire trail.

Phase 3 - Pond and Irrigation Improvements				
Mobilization	LS	1	$12,500.00	$12,500.00
Construction surveying	LS	1	$10,000.00	$10,000.00
Traffic control	LS	1	$5,000.00	$5,000.00
Site preparation and demolition	LS	1	$5,000.00	$5,000.00
Earthwork	LS	1	$70,000.00	$70,000.00
Pond liner	SF	34,750	$1.10	$38,225.00
Seapage control (piezometers)	EA	3	$500.00	$1,500.00
Water, sediment, and erosion control	LS	1	$15,000.00	$15,000.00
Drainage system (around pond)	LS	1	$25,000.00	$25,000.00
Irrigation pump wet well intake modification	LS	1	$7,000.00	$7,000.00
Pond fill line modification	LS	1	$6,550.00	$6,550.00
Pond aeration system	LS	1	$15,000.00	$15,000.00
Soil preparation	SF	170,000	$0.25	$42,500.00
Dryland seed and mulch	SF	170,000	$0.07	$11,900.00
Shade trees (pond area)	EA	21	$500.00	$10,500.00
Shrubs (pond area)	LS	1	$10,000.00	$10,000.00
Irrigation system (for seed establishment)	LS	1	$20,000.00	$20,000.00
Boulder pond edging (for picnic table areas)	LF	120	$100.00	$12,000.00
Subtotal Phase 3				$317,675.00
Design (Approximately 15%)				$47,325.00
Total Phase 3				**$365,000.00**

Assumptions:

Earthwork assumes all cut will be used as fill on site.
The existing wet well is deep enough to use with the new pond configuration.
The existing pump building will not be replaced.
The pond will not require a jurisdictional dam. Assumes that the dam will be built with site soils.
Assumes aeration system can operate from existing electric service on site.

Phase 4 - Park Entry, Restroom, Shelters, Pond Recreation and Aesthetic Improvements				
Mobilization	LS	1	$41,500.00	$41,500.00
Construction surveying	LS	1	$7,500.00	$7,500.00
Traffic control	LS	1	$2,500.00	$2,500.00
Site preparation and demolition	LS	1	$10,000.00	$10,000.00
Earthwork	LS	1	$25,000.00	$25,000.00
Water, sediment, and erosion control	LS	1	$7,500.00	$7,500.00
Water quality/detention structures	LS	1	$7,500.00	$7,500.00
Asphalt pavement (drop off lane)	SY	250	$35.00	$8,750.00
Crusher fines path	SF	7,000	$2.50	$17,500.00
Soil preparation	SF	50,000	$0.25	$12,500.00
Dryland seed and mulch	SF	50,000	$0.07	$3,500.00
Shade trees	EA	45	$500.00	$22,500.00
Evergreen trees	EA	12	$400.00	$4,800.00
Shrubs	LS	1	$7,500.00	$7,500.00
Irrigation system (for seed, tree, and shrub establishment)	LS	1	$15,000.00	$15,000.00
Restroom building	LS	1	$65,000.00	$65,000.00
Pond shelter	LS	1	$65,000.00	$65,000.00
Overlook shelter	LS	1	$45,000.00	$45,000.00
Site furnishings	LS	1	$35,000.00	$35,000.00
Concrete flatwork	SF	25,000	$5.00	$125,000.00
Decorative paving (entry area)	SF	11,500	$12.00	$138,000.00
Concrete accessible ramps	EA	1	$1,500.00	$1,500.00
Concrete curb and gutter	LF	175	$25.00	$4,375.00
Park entry sign	LS	1	$37,500.00	$37,500.00
Entry gateways/monuments	EA	2	$22,500.00	$45,000.00
Pond wall	CY	100	$800.00	$80,000.00
Form liner	SFF	480	$10.00	$4,800.00
Railing	LF	120	$150.00	$18,000.00
Electrical system (power to restroom building)	LS	1	$15,000.00	$15,000.00
Subtotal Phase 4				$872,725.00
Design (Approximately 15%)				$131,275.00
Total Phase 4				**$1,004,000.00**

Assumptions:

Restroom building will be a vault type structure. Assumes no plumbing to restroom. Assumes stone façade on bottom half of building.

Phase 5 - Playground and Bouldering Area				
Mobilization	LS	1	$42,500.00	$42,500.00
Construction surveying	LS	1	$10,000.00	$10,000.00
Traffic control	LS	1	$5,000.00	$5,000.00
Site preparation and demolition	LS	1	$7,500.00	$7,500.00
Earthwork	LS	1	$17,500.00	$17,500.00
Water, sediment, and erosion control	LS	1	$7,500.00	$7,500.00
Water quality/detention structures	LS	1	$7,500.00	$7,500.00
Drainage system	LS	1	$40,000.00	$40,000.00
Soil preparation	SF	35,000	$0.25	$8,750.00
Dryland seed and mulch	SF	35,000	$0.07	$2,450.00
Shade trees	EA	12	$500.00	$6,000.00
Evergreen trees	EA	26	$400.00	$10,400.00
Shrubs	LS	1	$15,000.00	$15,000.00
Irrigation system (for seed, tree, and shrub establishment)	LS	1	$13,000.00	$13,000.00
Boulder edging	LF	310	$65.00	$20,150.00
Log edging	LF	170	$50.00	$8,500.00
Rubberized surfacing (including concrete base)	SF	3,750	$22.00	$82,500.00
"Cascade" climbing boulders	LS	1	$7,500.00	$7,500.00
Climbing boulders (including marble "ice" boulder)	LS	1	$40,000.00	$40,000.00
Climbing pinnacles	LS	1	$80,000.00	$80,000.00
"Rattlesnake" slide and climbing sculpture	LS	1	$45,000.00	$45,000.00
Bridge	LS	1	$3,500.00	$3,500.00
"Prairie dog" climbing wall	LS	1	$75,000.00	$75,000.00
"Prairie dog" tunnels	LS	1	$30,000.00	$30,000.00
"Prairie dog" slide	LS	1	$2,500.00	$2,500.00
Cat tail spinners	EA	2	$6,500.00	$13,000.00
"Trout" climbing sculptures (3 total)	LS	1	$22,500.00	$22,500.00
Water source boulder	LS	1	$12,000.00	$12,000.00
Copper water service line (to water runnels)	LF	350	$17.50	$6,125.00
Water runnels	LS	1	$5,000.00	$5,000.00
Sand	CY	20	$40.00	$800.00
Tree climber	LS	1	$12,500.00	$12,500.00
Woodland boardwalk	LS	1	$40,000.00	$40,000.00
Engineered wood fiber surfacing	CY	200	$60.00	$12,000.00
Entry monuments	LS	1	$2,500.00	$2,500.00
Concrete flatwork	SF	5,000	$6.00	$30,000.00
Concrete edger	LF	125	$25.00	$3,125.00
Concrete thickened edge	LF	85	$20.00	$1,700.00
Concrete flatwork - lithocrete river paving	SF	1,250	$40.00	$50,000.00
Concrete stairs	CY	6	$800.00	$4,800.00
Concrete walls	CY	55	$800.00	$44,000.00
Hand rails	LF	50	$75.00	$3,750.00
Site furnishings	LS	1	$20,000.00	$20,000.00
Playground shelter	LS	1	$35,000.00	$35,000.00
Concrete accessible ramps	EA	3	$1,000.00	$3,000.00
Subtotal Phase 5				$909,550.00
Design (Approximately 15%)				$136,450.00
Total Phase 5				**$1,046,000.00**

Total Phase 1 through Phase 5	**$3,236,000.00**

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Landscape Architecture
Irrigation Design

VILLAGE GREENS NORTH
PHASE NO.1 MASTERPLAN

EXISTING IRRIGATION SYSTEM ASSESSMENT
AND
POND SIZING / DRAW DOWN ANALYSIS
January 5, 2010

IRRIGATION SYSTEM ASSESSMENT:

a) Existing Irrigation System Configuration and Operation:

It currently takes twelve to thirteen hours a day, five days a week, to apply the historical E.T. irrigation water requirement at Village Greens South. This expanded water window causes conflicts with the permitting and programming of the site, as well as, routine maintenance operations.

In order to shrink the water window, this analysis assumes that the existing irrigation pond, pump station and portions of the existing mainline network will be replaced as required to reduce the water out window to industry standards of eight hours a day, five days a week.

b) Cross Connection Potential:

Historically, once the seasonal irrigation requirement at Village Greens South exceeds the production capacity of the well, a system of isolation valves are closed which takes the south half of the facility off of the well source. The south portion of the site is irrigated roughly May through September, with potable water from an existing 4" potable back up tap located at the south end of the facility.

Although back flow protected, this use of the same irrigation main line and lateral piping to alternatively convey potable and non-potable water could present a cross contamination potential.

It is the author's recommendation that the new irrigation pump station be sized to serve the entire build out irrigation requirements for both the existing improvements at Village Greens South and the proposed improvements at Village Greens North through the entire irrigation season.

Additionally it is the author's recommendation that all future irrigation water be stored in and pumped out of the irrigation pond including any supplemental potable water required by higher E.T. rates May through September. This required supplemental irrigation water could be supplied from the existing 4" potable backup tap and diverted into the pond in a manner that will maximize turning of the water column for water quality enhancement.

c) Well Capacity:

The production capacity of the existing irrigation well is approximately 90 gallons per minute. This well capacity of 90 gallons per minute, multiplied by 60 minutes, equals 5,400 gallons per hour, multiplied by 24 hours, equals 129,600 gallons per day, multiplied by 28 days, equals 3,628,800 gallons of water per month with the well producing continuously except when taken off line for service two days per month.

d) Recharge Volume Requirements:

Based on historical E.T. rates, the 1,339,112 Sq. Ft. of existing irrigated turf grass at Village Greens South will require the application of the following volume of water each month during the irrigation season, (see Irrigation System Annual Water Consumption / Water Budget Projection).

	Monthly Irrigation Requirement	Monthly Well Capacity	Well Surplus Capacity or Required Potable Supplement
April	1,602,649 gal.	3,628,800 gal.	2,026,151 gal. available surplus
May	4,627,650 gal.	3,628,800 gal.	999,850 gal. required supplement
June	5,869,703 gal.	3,628,800 gal.	2,240,903 gal. required supplement
July	6,310,431 gal.	3,628,800 gal.	2,681,631 gal. required supplement
August	5,509,107 gal.	3,628,800 gal.	1,880,307 gal. required supplement
September	4,006,623 gal.	3,628,800 gal.	377,823 gal. required supplement
October	1,602,649 gal.	3,628,800 gal.	2,026,151 gal. available surplus

e) Recharge G.P.M. Requirements:

To offset the required irrigation draw down from May to September, the existing irrigation well would be discharging into the newly reconfigured irrigation pond continuously twenty four hours a day, seven days a week at 90 G.P.M. Simultaneously the potable diversion pipe would be discharging into the newly reconfigured irrigation pond continuously twenty four hours a day seven days week at the supplemental flow rates identified in the table below.

	Total Recharge Requirement	Well Capacity	Well Surplus Capacity or Required Potable Supplement
April	39 G.P.M.	90 G.P.M.	51 G.P.M. surplus capacity
May	114 G.P.M.	90 G.P.M.	24 G.P.M. required supplement
June	145 G.P.M.	90 G.P.M.	55 G.P.M. required supplement
July	156 G.P.M.	90 G.P.M.	66 G.P.M. required supplement
August	136 G.P.M.	90 G.P.M.	46 G.P.M. required supplement
September	99 G.P.M.	90 G.P.M.	9 G.P.M. required supplement
October	39 G.P.M.	90 G.P.M.	51 G.P.M. surplus capacity

f) Irrigation Pond Draw Down Analysis:

The surface area of the newly reconfigured irrigation pond is 50,025 Sq. Ft. The weekly irrigation water volume requirement, during the month of July, is 210,910 Cu. Ft. of water, (see Irrigation System Annual Water Consumption / Water Budget Projection).

Dividing the weekly July irrigation water volume requirement of 210,910 Cu. Ft., by the five irrigation cycles per week, results in a daily eight hour irrigation cycle pond draw down of 42,182 Cu. Ft. of water during the month of July.

The irrigation cycle draw down of 42,182 Cu. Ft., divided by the pond surface area of 50,025 Sq. Ft., equals a per cycle draw down of the pond surface of .84' or 10.1".

However, during this eight hour draw down the pond is recharging at 156 G.P.M. (90 G.P.M. from the well and 66 G.P.M. from the supplemental potable diversion pipe) see table above. This continuous fill will off set the per cycle draw down by 2.4" reducing the per cycle draw down to 7.7".

Additionally, during the sixteen hour interval between irrigation cycles, the continuous recharge of 156 G.P.M. will raise the pond elevation by an additional 4.8". which will reduce the twenty four hour draw down to 2.9".

The irrigation pond will be drawn down an additional 2.9" for each successive irrigation cycle until we reach a non irrigation day at which time the pond elevation will be raised 7.2" by the continuous recharge of 156 G.P.M. During the second non irrigation day the pond surface will rise another 7.2" balancing the draw down to 0.0" at weeks end.

Weekly pond surface fluctuation during the month of July (assumed static pool surface elevation of 100.0'):

July Draw Down	Draw Down 10pm – 6am	Recharge 10pm-6am	Recharge 6am-10pm	Net change in inches	Cumulative elev. change
Monday Irrigation	10.1"	2.4"	4.8"	- 2.9"	- 2.9" Elev. 99.7'
Tuesday Irrigation	10.1"	2.4"	4.8"	- 2.9"	- 5.8" Elev. 99.5'
Wednesday No water	0.0"	2.4"	4.8"	+ 7.2"	+ 1.5" Elev. 100.1'
Thursday Irrigation	10.1"	2.4"	4.8"	- 2.9"	- 1.4" Elev. 99.8'
Friday Irrigation	10.1"	2.4"	4.8"	- 2.9"	- 4.3" Elev. 99.6'
Saturday Irrigation	10.1"	2.4"	4.8"	- 2.9"	- 7.2" Elev. 99.4'
Sunday No water	0.0"	2.4"	4.8"	+ 7.2"	-0.0" Elev. 100.0'

g) Long Term Objectives:

Given the size of the facility and the pressure of continuous athletic permitting and programming, the long term renovation goal would be to reconfigure the irrigation system as follows:

I. Install a new perimeter mainline distribution loop to serve the entire site, sized as required to shrink the water window to five - eight hour irrigation cycles per week.
II. Install a series of irrigation sub mains (served by the perimeter distribution loop). Each of the irrigation sub mains would be set up independently with Bermad 910 WMP Hydrometer master valves that will perform both pressure regulation and read flow.
III. Install a new Maxicom controller to serve each of the irrigation sub mains.

IRRIGATION SYSTEM GALLON PER MINUTE DEMAND CALCULATION SHEET:

Project: Village Greens North - Phase No 1 Masterplan Date: April 20, 2010

EXISTING VILLAGE GREENS SOUTH ATHLETIC FIELDS AND PASSIVE PERIMETER TURFGRASS AREAS
IRRIGATION SYSTEM PEAK FLOW WATER VOLUME REQUIREMENTS:
EXISTING TURF GRASS AREAS = 1,339,112 SQ. FT.

Well service area May through September = 53% of the total irrigated area or 709,729 Sq. Ft.
The existing watering schedule for turf grass maintenance is 5 -13 hour water cycles per week.

AREA OR VOLUME:	AREA OR VOLUME DESCRIPTION:	(X OR / BY:)	VALUE:	
709,729	SQ. FT. OF IRRIGATED AREA	MULTIPLIED BY:	0.148	EQUALS:
105040	CU. FT. OF WATER REQUIRED FOR WEEKLY JULY E.T.	MULTIPLIED BY:	0.80	EQUALS:
84032	WEEKLY JULY E.T. ADJ. FOR TURF	MULTIPLIED BY:	7.48	EQUALS:
628559	GALLONS OF WATER REQUIRED PER WEEK	DIVIDED BY:	5.00	EQUALS:
125712	GALLONS REQUIRED PER DAY OR CYCLE	DIVIDED BY:	13.00	EQUALS:
9670	GALLONS OF WATER REQUIRED PER HOUR	DIVIDED BY:	60.00	EQUALS:
161	GALLONS OF WATER REQUIRED PER MINUTE	DIVIDED BY:	0.75	EQUALS:
214.89	GALLONS OF WATER REQUIRED PER MINUTE TO APPLY THE TURF GRASS ADJUSTED WEEKLY JULY E.T. WATER REQUIREMENT TO THE TURF AREA IDENTIFIED ABOVE WITH A SYSTEM EFFICIENCY OF 75%.			

GENERAL NOTES:

The G.P.M. demand calculation above is based on the following Evapotranspiration Rates provided by Denver Water:

April ---------- 1.80"
May ---------- 5.20"
June ---------- 6.60"
July ---------- 7.10"
August ---------- 6.20"
September ------- 4.50"
October ---------- 1.80"

TAP SIZE CAPACITY CRITERIA: Maximum Safe Flow = 7.5 F.P.S.

1.0" = 18 G.P.M. 1.5" = 40 G.P.M. 2.0" = 70 G.P.M.
3.0" = 150 G.P.M. 4.0" = 275 G.P.M. 6.0" = 575 G.P.M.

IRRIGATION SYSTEM ANNUAL WATER CONSUMPTION / WATER BUDGET PROJECTION:

Project: Village Greens North - Phase No.1 Masterplan Date: April 20, 2010

AVERAGE ANNUAL IRRIGATION SYSTEM WATER REQUIREMENTS FOR:

Well service area May through September = 53% of the total irrigated area or 709,729 Sq. Ft.

APPROXIMATE SQ. FT. OF WELL SERVICE AREA: 709,729 Sq. Ft.

Irrigation Season:	April	May	June	July	August	Sept.	Oct.	Total:
Historical E.T.	1.8	5.2	6.6	7.1	6.2	4.5	1.8	
Turf Grass E.T. Coefficient 80%	80%	80%	80%	80%	80%	80%	80%	
Water Requirement in Inches	1.44	4.16	5.28	5.68	4.96	3.60	1.44	
System Efficiency	75%	75%	75%	75%	75%	75%	75%	
Monthly Requirement In Inches	1.92	5.55	7.04	7.57	6.61	4.80	1.92	**35**
Weekly Requirement In Inches	0.48	1.39	1.76	1.89	1.65	1.20	0.48	
Monthly Requirement In Cubic Feet	113,557	327,895	415,901	447,129	390,351	283,892	113,557	**2,092,281**
Weekly Requirement In Cubic Feet	28,389	81,974	103,975	111,782	97,588	70,973	28,389	
Monthly Requirement In Gallons	849,404	2,452,653	3,110,941	3,344,527	2,919,825	2,123,509	849,404	**15,650,263**
Weekly Requirement In Gallons	212,351	613,163	777,735	836,132	729,956	530,877	212,351	
Annual Requirement In Acre Feet: ----------								**48.03**