

CITY OF BOULDER
OPEN SPACE BOARD OF TRUSTEES AGENDA ITEM

MEETING DATE: May 13, 2015

AGENDA TITLE: Public hearing and consideration of a recommendation to City Council regarding the South Boulder Creek Major Drainageway Flood Mitigation Plan.

PRESENTER/S:

Tracy Winfree, Interim Director, Open Space and Mountain Parks
Jeff Arthur, Director of Public Works for Utilities
Don D'Amico, Ecological Systems Supervisor, Open Space and Mountain Parks
Kurt Bauer, Engineering Project Manager
Kristin Dean, Utilities Planner

EXECUTIVE SUMMARY:

A Recommended Plan for flood mitigation along South Boulder Creek was presented to the public, Open Space Board of Trustees (OSBT), Water Resources Advisory Board (WRAB), and City Council at a Study Session in 2014. The Recommended Plan was comprised of three phases:

Phase I: Regional detention facility at US 36
Phase II: West Valley improvements
Phase III: Arapahoe Avenue detention

In 2014, the WRAB and City Council were generally supportive of the mitigation proposed under Phases II and III. The OSBT also indicated their support for Phases II and III as it was not seen to have effects on city open space properties. However, significant concern was voiced by both boards and by City Council regarding potential environmental impacts, including those to Open Space and Mountain Parks (OSMP) lands from the proposed US 36 regional stormwater detention facility (Phase I). As a result, staff was directed to evaluate other options, including potential use of a larger portion of the University of Colorado's CU South property to reduce impacts to environmentally sensitive areas.

Since then, six additional options have been developed for US 36 detention. All options prevent the overtopping of US 36 during a 100-year design storm and reduce flooding impacts downstream and each have fewer impacts to OSMP than the original proposal. This memorandum presents the US 36 detention options, a comparison of potential impacts to OSMP and CU lands and a summary of potential next steps. Staff is recommending that the Phases II and III concepts remain unchanged in the mitigation master plan and that Phase I be accomplished using Colorado Department of Transportation (CDOT) Right of Way (ROW) (Option D) for construction of a regional stormwater detention facility at US 36. In this alternative, the berm would be located within the existing CDOT right of way, and OSMP lands would only be affected when stormwaters are detained. Each of the

additional options has a greater impact to CU land than the plan that was presented in 2014. However, while CU prefers the 2014 plan, they have also indicated they are willing to discuss use of their land to facilitate the implementation of Option D for regional detention.

STAFF RECOMMENDATION:

Staff requests Open Space Board of Trustees consideration of this matter and recommends action in the form of the following motion:

The Open Space Board of Trustees recommends that City Council accept the South Boulder Creek Major Drainageway Flood Mitigation Plan including Option D (single berm using Colorado Department of Transportation Right of Way - and requiring disposal of no City of Boulder Open Space and Mountain Parks lands) for 'Regional Detention at US 36 along with the Downstream Improvements as the recommended comprehensive alternative to mitigate flood risks associated with South Boulder Creek.

COUNCIL FILTER IMPACTS:

- Economic: A total of 700 structures (442 within city limits) and approximately 1,200 dwelling units (962 within city limits) are located within the 100-year South Boulder Creek floodplain. A risk assessment completed in June 2009 estimated a 100-year event would result in \$215 million in damages.¹ South Boulder Creek (SBC) had the greatest reported property damage from the 2013 flood of all the city's 15 major drainageways. Approximately 362 structures (893 dwelling units) within the city limits would no longer be located in the 100-year floodplain if the study recommendation is constructed (approximately 80 structures would remain in the floodplain within city limits under the recommended plan). Structures removed from the floodplain would be less likely to be damaged from a flood and would also benefit from no longer being subject to paying for flood insurance.
- Environmental: One of the Boulder Valley Comprehensive Plan (BVCP) general policies emphasizes the city's commitment to open space preservation. OSMP land within the project area has some of the highest ecological values in the Boulder Valley. The project area on OSMP lies entirely within the South Boulder Creek State Natural Area (SBCSNA) which was designated by the State of Colorado in recognition of the state-wide significance of this exceptional riparian and floodplain ecosystem – including two federally threatened species: the Preble's meadow jumping mouse (PMJM) and the Ute ladies' - tresses orchid (ULTO) habitat, tallgrass prairie, wetlands, habitat for declining grassland and riparian bird species, habitat for declining amphibians such as the northern leopard frog, and habitat for declining native fish. Tallgrass prairie is considered one of the most endangered plant communities in the world and OSMP land in the project area contains some of the highest quality remaining tallgrass prairie in the state and the region. Additionally, Boulder's ULTO population is one of the largest within the entire range for this federally threatened

¹ This estimate includes properties in the city and the county.

plant species. This area is also managed as part of one of the oldest and most productive agricultural landscapes on city Open Space. While previous flood mitigation options would have directly impacted these resources, construction of the recommended regional detention facility berm at US 36 (Option D) has fewer impacts on OSMP lands and associated resources. In times of flooding, a portion of Open Space land behind the berm will be inundated, depending on the magnitude of the storm, and sediment deposition is likely to occur. It should be noted that this area is currently in the 100-year floodplain, which could result in inundation and sediment deposition without the berm. However, these effects are likely to increase by the construction of the berm. Newly deposited sediments will require management to avoid the establishment and spread of invasive plant species and habitats impacted by additional sediment deposition may require restoration.

- **Social:** The flood hazards associated with SBC are a significant risk to life, property and business. The SBC floodplain includes hundreds of residential structures, affordable housing, senior housing, medical facilities, and numerous businesses. In addition, flood modeling predicts US 36 would be flooded during major storm events, eliminating use of a major thoroughfare into and out of the city. While construction of the study recommendation would temporarily cause disruption to local residents, businesses, and transportation routes, mitigating these hazards would further the city's social sustainability goals and benefit a diverse set of community stakeholders by protecting them from significant damage from a large flood event.

OTHER IMPACTS:

- **Fiscal:** Implementation of the study recommendation is estimated to cost approximately \$46 million for all three phases. Funding in the 2015-2020 Department of Public Works Utilities Division CIP budget for this project is \$11,750,000. Staff will be recommending increasing the budget in the 2016-2021 CIP by \$15 million (in 2018) to a total of \$26,750,000. The project could be constructed in phases with each phase estimated to cost from \$11 - \$25 million. The city would also seek grants to fund this project.
- **Staff Time:** Time for completing the study is included in existing work plans. However, implementation of the recommended option will require additional staff time from multiple city departments including Public Works, Comprehensive Planning & Sustainability, OSMP and Parks & Recreation.

BOARD AND COMMISSION FEEDBACK:

Conceptual alternatives were first presented to WRAB in 2010 with a recommendation from the board to move forward with four of nine alternatives. The OSBT was updated by staff in 2010. A staff recommendation was presented in August 2014 to the OSBT and WRAB resulting in the following motions:

OSBT 2014 Motions:

- Recommend proceeding with the ‘West Valley Improvements’ and ‘Arapahoe Detention’ phases of the ‘Regional Detention at US 36 with Downstream Improvements’ flood mitigation alternative at this time. The motion passed unanimously.
- Recommend investigating alternatives to the ‘Regional Detention at US 36’ component which may have lesser potential for environmental impacts. The motion passed unanimously.
- Make a statement to City Council: the Board believes that constructing a regional detention facility at US 36 would require a significant disposal of Open Space lands, which would be subject to all applicable Open Space charter provisions. The motion passed unanimously.

The motions passed 4-0, Dunbar absent.

WRAB 2014 Motions:

- Recommend that City Council accept the ‘West Valley Improvements and Arapahoe Detention Phases’ of the South Boulder Creek Major Drainageway Plan and the ‘Regional Detention at U.S. 36 with Downstream Improvements’ as the recommended alternative to mitigate flood risks associated with South Boulder Creek.
- Recommends proceeding with the ‘Regional Detention at US 36’ component of the alternative only after looking at alternatives which may have lesser potential for environmental impacts, and which may provide faster and less costly opportunities for equivalent mitigation in that area, such as use of CU property detention, private property detention, and eminent domain options.

The motions passed unanimously (5-0).

A summary of the South Boulder Creek flood mitigation project along with board recommendations were presented to City Council at a Study Session in September 2014. City Council supported development of additional alternatives involving CU South to reduce potential environmental impacts.

This item will be presented to the WRAB on May 18, 2015.

PUBLIC FEEDBACK:

Conceptual alternatives were initially presented at a public meeting in March 2010. Refined alternatives were then presented at a second public meeting in September 2010. A public open house was conducted just prior to the Aug. 18, 2014 WRAB meeting to present the recommended plan and answer questions. Two OSBT meetings were also held in 2014 and there were public comments at both meetings.

The “South Boulder Creek Action Group,” comprised of residents in the Frasier Meadows area has met with several City Council members, several WRAB members, and city staff. They also presented a 15-minute video to the OSBT at the board’s April 8, 2015 meeting. Approximately 65 residents from the Frasier Meadows area attended the April 27, 2015 WRAB meeting. Several residents spoke at the meeting and also presented a video of the 2013 flood.

BACKGROUND:

In the mid-1990s, CU evaluated the purchase of land located at US 36 and Table Mesa Drive. During this evaluation, inaccuracies in the 1986 regulatory flood mapping were discovered. Studies commissioned by the city and the Urban Drainage and Flood Control District (UDFCD) revised the 100-year floodplain and estimated that a 100-year storm event would result in approximately \$215 million in damages in the South Boulder Creek drainage basin. During the 2013 flood, South Boulder Creek overtopped US 36. Reported property damage in the South Boulder Creek floodplain was the greatest of all the city's 15 major drainageways. Additional background information can be found on the South Boulder Creek Major Drainageway Flood Mitigation Project web site (www.southbouldercreek.com) and in the study report ([Draft South Boulder Creek Major Drainageway Plan](#)).

The South Boulder Creek Flood Mitigation Planning Study began in early 2010 and is funded by the city and the UDFCD. The study, completed by an engineering consulting firm, focused on developing and evaluating alternatives to mitigate flood hazards affecting structures and areas within the current incorporated city limits, primarily within the West Valley area (see **Attachment A**).

Conceptual alternatives initially developed included a wide range of flood mitigation measures. These concepts were presented at a public meeting and to the WRAB in 2010. The concepts were subsequently screened based on input received at the meeting, hydraulic modeling and field visits. The results were used to formulate 15 alternative plans. Concept-level sizing, configurations and costs were developed for each of these 15 plans along with an estimate of likely benefits and environmental and social impacts. From this information, nine "Best Alternative Plans" were developed. These alternatives were presented at a second public meeting and to the WRAB in 2010. The WRAB recommended moving forward with the following four alternatives:

1. Maintaining the status quo;
2. High Hazard Zone mitigation and critical facility protection;
3. Regional detention at US 36 with downstream improvements; and
4. Distributed regional detention.

In 2014, a draft recommended plan was presented to the public, OSBT and WRAB and to City Council at a Study Session. The recommended plan included the following phases:

1. A regional stormwater detention facility at US 36;
2. West Valley improvements including a stormwater detention facility at or near Manhattan Middle School, a small stormwater detention storage area at the intersection of Foothills Parkway and Baseline Road, and placing a segment of Dry Creek No. 2 Ditch in a 72-inch diameter pipe;
3. A stormwater detention facility located at Flatirons Golf Course.

Both boards made motions to recommend that City Council accept the second and third phases of the recommended plan but did not support the Phase I regional detention concept without first evaluating other options to reduce environmental and other Open Space impacts. Additionally, City Council directed staff to involve CU in discussions to develop a US 36 regional stormwater detention facility which would use more of their land in order to effectively reduce environmental and other Open Space impacts (see Board and Commission Feedback section above).

In response to the direction given by council, six new options for detention at US 36 have been developed. From a technical aspect, *all* options function to effectively mitigate flooding from South Boulder Creek in the same capacity. Construction of all the phases of the recommended alternative would eliminate overtopping of US 36 and subsequent flooding in the West Valley during a major storm event and all of the options reduce impacts to environmental resources and to Open Space compared to the 2014 recommended plan.

City Utilities and OSMP staff met with CU on several occasions to discuss these options and to obtain their feedback. In those meetings, as well as at the 2014 public meetings, CU has stated they are willing to consider using a portion of the CU South parcel for flood mitigation. In addition, staff has also met with CDOT to discuss an option that would use existing CDOT ROW. CDOT has stated that they are willing to work with the city to develop an agreement for use of their existing ROW for this project.

The CU-South property consists of 302 acres. This property is located outside of city limits in Boulder County. CU developed a conceptual master development plan for this property in 2004. CU's master plan identifies areas for building potential, flood storage, natural areas, ponds, and access points. This plan has not gone through any city review processes, nor has it been endorsed by the city. The 2010 BVCP currently designates the majority of CU South parcel as open space (214 acres) and low- and medium-density residential designation (27 and 67 acres, respectively). The property is located in Area II which are lands where the city anticipates future annexations. If City Council supports a flood mitigation alternative that requires land use discussions with CU, it is anticipated that those discussions would be integrated into the BVCP update that is currently underway.

ANALYSIS:

Based on feedback from the 2014 public process, six new and *very conceptual* options for stormwater detention at US 36 have been developed. As a result, engineering features and anticipated resource impacts presented in this memorandum are master planning level, but all of the options would prevent the overtopping of US 36 from a 100-year design storm. To avoid confusion with previously considered flood mitigation alternatives, the seven concepts for providing stormwater detention at U.S. 36 are labeled as Options (A-G). Option A is the concept presented in 2014.

The options are variations of single and dual berm detention systems. Three dual berm detention options have been developed that include varying degrees of fill and excavation (Options E, F, and G). The dual berm detention systems require breaching the existing CU South levee and constructing an open channel within the CU South parcel. Staff has concerns with these options because debris could block the breach in the levee which would prevent water from reaching the secondary detention basin.

Three options have been developed that modify the single berm system (Option A) presented in 2014 (Options B, C, and D). These options also vary in the degree of fill and excavation. It should be noted that only Option A (the 2014 option) impacts federally designated PMJM critical habitat along South Boulder Creek. However, all other options would impact habitat occupied by PMJM. Impacts to PMJM habitat from Option D have already been mitigated by CDOT. **Attachment B** illustrates Options A through G. **Table**

1.0 presents a comparison of analysis factors for the options including environmental impact.

Table 1.0: Summary Comparison of Conceptual Stormwater Detention Options Upstream of US 36

Green = lowest impacts of options compared

Yellow = medium impact relative to other options compared

Red = greatest impact of options compared

Option	Total Impacts to CU Parcel ¹ (acres)	Total Berm impacts to OSMP (acres)	Total Detention impacts to OSMP ² (acres)	Maximum Berm Height (feet)	Est. Cost (\$millions)	Est. Benefit (\$millions)	Est. Benefit to Cost Ratio
A – 2014 Option	56	5	35	34.5	24	26.5	1.1
B - Single Berm with Excavation	90	2	5	27.5	21.5	26.5	1.2
C – Single Berm with Excavation and Fill	80	3	17.5	30.5	22.5	26.5	1.2
D – Single Berm CDOT ROW	79	0	19	30.5	22.3	26.5	1.2
E- Dual Berm no Excavation	142	1	3.5	26.5	26	27 ³	1
F – Dual Berm with Excavation	100	2	5	27.5	31	27	0.9
G – Dual Berm with Excavation and Fill	99	0.5	8.5	28.5	34.5	27	0.8

¹ Includes berm footprint and detention storage area

² Includes only the storage pool area, not the current 100-year floodplain area

³ The dual berm options do not reduce the floodplain downstream, but do reduce the flood depth in certain locations. Thus, the additional benefits from the dual berms reflect a decrease in damage from flooding, but it is still assumed that the structures in this area do experience some damage.

CU has stated that their preferred regional detention plan is Option A because it uses the least amount of university land compared to other options. CU has expressed an interest in working with the city to identify potential sites on their property where environmental impacts associated with Option A could be mitigated and additional enhancements could potentially be provided; however, staff does not believe that this approach is consistent with prior direction from council and feedback from the boards. While Option D does impact more of CU’s land, CU has indicated that they are willing to consider this option. CU is also open to discussing Option G, but staff does not recommend any dual berm configurations due to their cost, visual impacts, and relatively low benefit to cost ratio.

Staff recommends including Phases II and III unmodified as presented in 2014 in the final mitigation plan. Staff also recommends Option D (single berm using CDOT ROW) as the concept for providing regional stormwater detention to prevent overtopping of US 36 during a 100-year design storm. This alternative would provide the least direct impact to OSMP lands and environmental resources from berm construction.

This CDOT ROW option calls for modifying the multi-use path that CDOT is currently constructing within land it owns. CDOT has already mitigated for environmental impacts on this land. Staff anticipates little or no mitigation will be necessary for modification of the path for the regional stormwater detention berm.

Option D will require modification to the multi-use path including constructing walls and raising the path to a maximum height of 9 feet above US 36 (it is currently being constructed at grade to approximately 2 feet lower than the highway). Conceptually all permanent features could fit within the existing CDOT ROW, but the design phases would need to confirm this assumption and identify any possible temporary construction and maintenance impacts that would need to be mitigated.

CDOT representatives have stated that should the ultimate US 36 configuration be constructed, additional lanes could be built in their existing ROW on the north side of the existing highway. This would eliminate the need to remove and replace the path a second time, and would leave the berm unaffected.

CDOT has also indicated in writing that they are agreeable to the city’s *request to consider* developing an agreement to use a portion of the US 36 Phase 2 Bikeway located within CDOT ROW as a berm provided that US 36 lanes and the permanent water quality features remain intact. The estimated cost for this option is \$23.4 million with a benefit to cost ratio of 1.12.

If City Council accepts Option D as the recommended option, the plans would be refined according to agreements reached with CDOT and CU. This mitigation plan would then need to be reviewed through the Community Environmental Assessment Process (CEAP) and the berm would need to be reviewed and approved by the Office of the State Engineer.

Table 2.0 below presents a summary of the anticipated next steps resulting from potential City Council decisions.

Table 2.0: Summary of Next Steps

Council Decision	Environmental Process	CU Agreements	CDOT Agreements	Comp Plan Updates	Outcomes: # Structures in 100-Yr. Floodplain within City Limits
Status Quo	No	No	No	No	442
Phase II and III Approved but US 36 Detention not Approved	CEAP	No	No	No	442
Staff Recommended Option D with Phases II and III Approved	CEAP ¹ /OSE ²	Yes	Yes	Yes	80
Option C with Phase II and III Approved	EA or EIS/OSE	Yes	No	Yes	80
Option A with Phases II and III Approved	EIS/OSE	Yes	No	Yes	80
Any of Options B, E, F, or G with Phase II and III Approved	EA or EIS/OSE	Yes	No	Yes	80

1. Assumes Option D can be constructed with no impacts to Threatened or Endangered Species or regulated wetlands.
2. Office of State Engineer review and approval of the detention facility.

City Council acceptance of a capital improvement project also requires a design phase and floodplain remapping submittals to FEMA, and may require wetland permits and USFWS consultation.

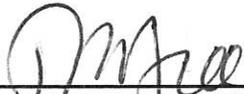
The remaining options are not being recommended at this time as they all have similar or greater berm and associated environmental impacts to OSMP lands. All other options, except for Option A, have greater impact on CU property. Additionally, all of the dual berm options carry a higher cost and a lower benefit to cost ratio than the single berm options.

NEXT STEPS:

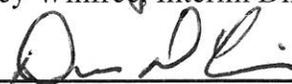
The revised options and staff recommendation along with the OSBT and WRAB motions will be presented to City Council on Aug. 4, 2015. Should City Council accept the South Boulder Creek Flood Mitigation Plan with Option D as the concept for US 36 regional detention, city staff will initiate discussions with CU and CDOT in order to further refine the plans. Consideration of changes to the land use designations on CU Campus South as a component of the BVCP update will also factor into these discussions with CU. A CEAP will also be initiated once plans reach the appropriate stage of refinement.

No direct impacts to city-owned lands managed as open space have been identified in Option D. Should further refinements result in a design that has direct impacts to city open space, OSMP staff will lead an evaluation of those impacts for consistency with OSMP charter purposes. Any such additional impacts and staff's conclusions about consistency with the charter purposes for open space will be presented to the OSBT for consideration. City staff will make no further commitments to designs with impacts to OSMP lands prior to consulting with the OSBT, and if appropriate City Council. Should it be determined that disposal of city open space is necessary, the appropriate process will be followed.

Submitted by:



Tracy Winfree, Interim Director

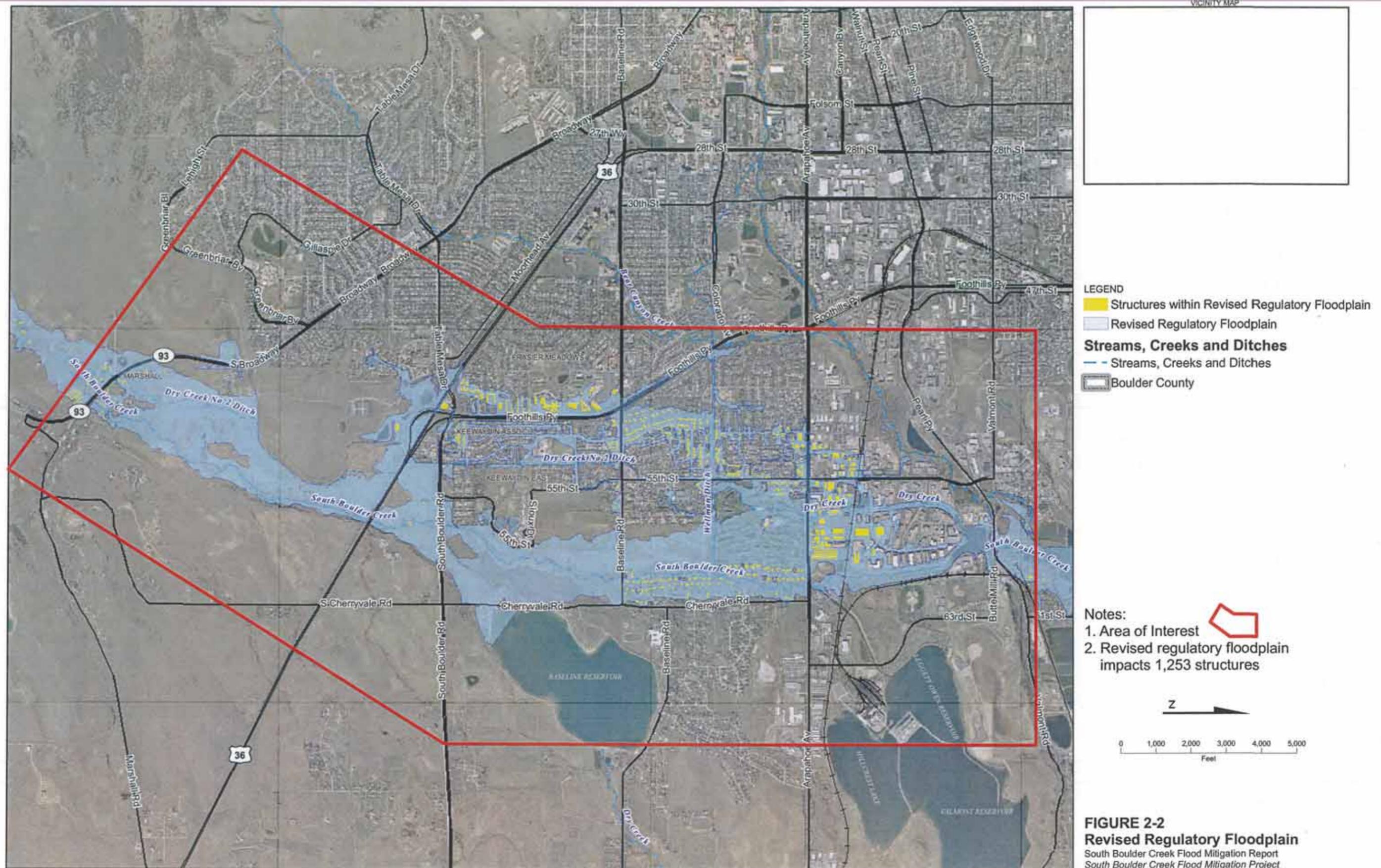


Don D'Amico, Ecological Systems Supervisor

ATTACHMENTS:

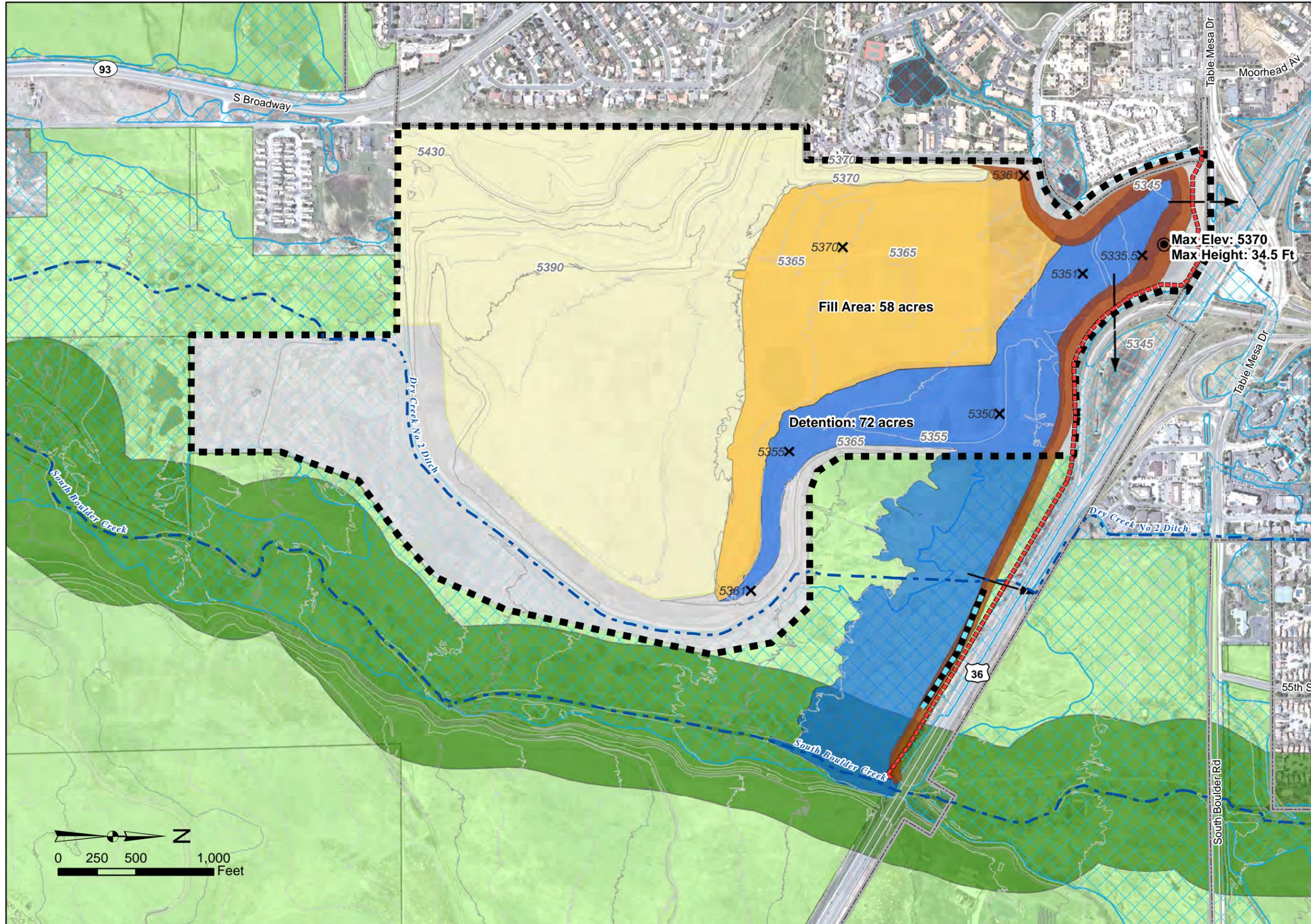
- A. Study Area
- B. US36 Regional Detention Options A-G

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Stormwater Detention Upstream of US36

South Boulder Creek Flood Mitigation Project



Option A

Alternative presented to WRAB in 2014

- Single Berm
- No excavation
- With fill
- On CU and OSMP property
- Max Berm Height 34.5ft

Description	Acres
Total CU Property	302
CU Property Impacted	56
CU Building Potential Impacted	6
OSMP Property Impacted	40

Max Elev: 5370
Max Height: 34.5 Ft

Fill Area: 58 acres

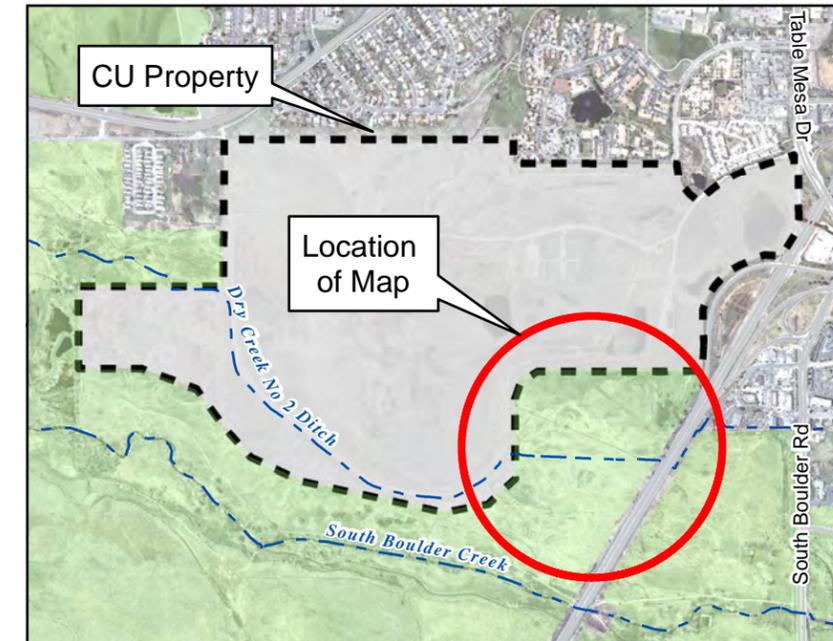
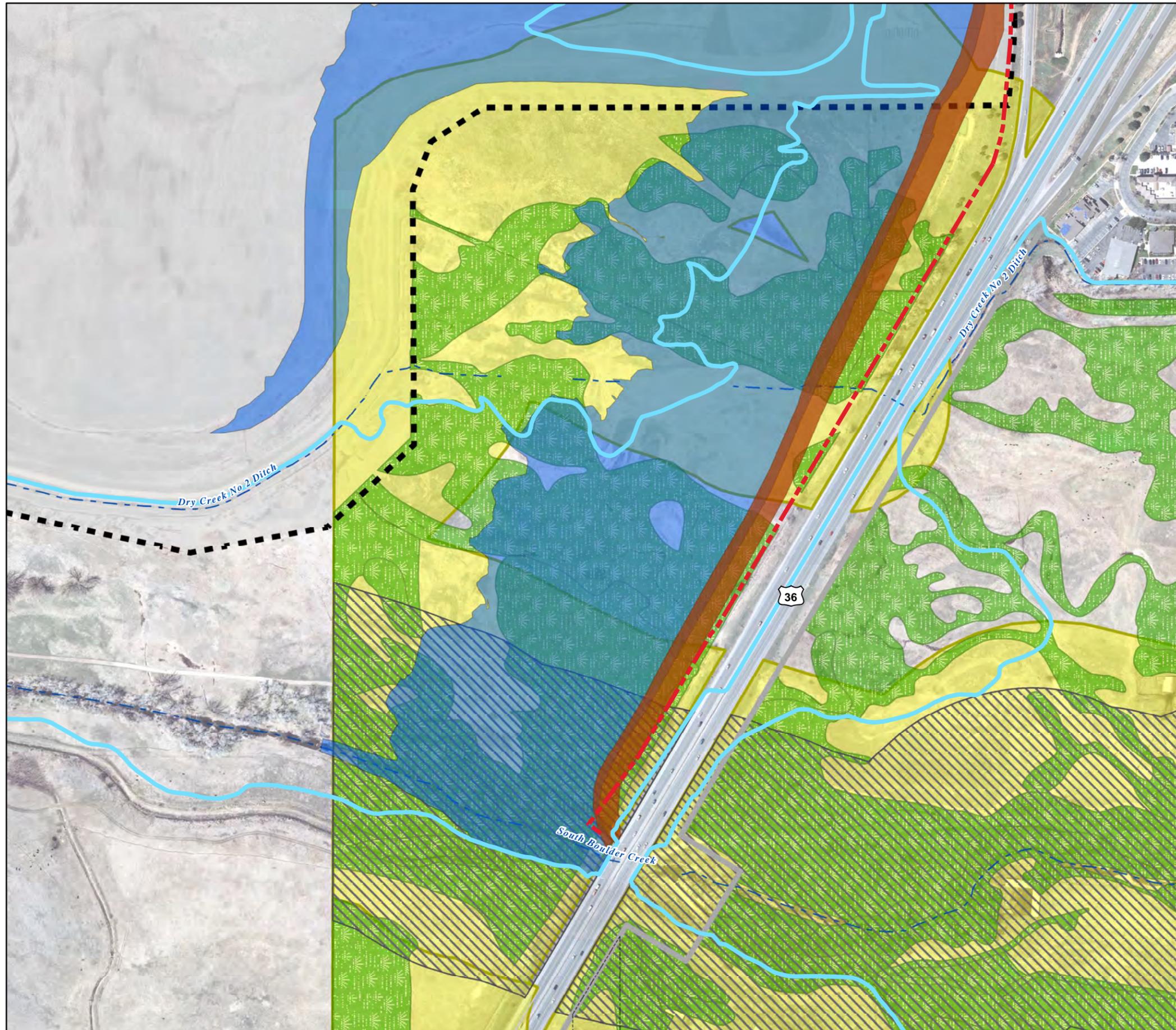
Detention: 72 acres

Proposed Conditions

- New Berm
- Pool Contained By Fill or Cut Slope
- Limits of Excavation
- Detention Pond Area
- Fill Area
- Out of 100yr Inundation
- X Spot Elevation
- Max Berm Elevation
- Discharge Location
- Spillway

Existing Conditions

- Boulder City Limits
- CDOT Existing ROW
- CU Site Boundary
- OSMP Property
- Prebles Critical Habitat Area
- Effective 100 Year Floodplain
- 5 Foot Contours
- 10 Foot Contours



LEGEND

- CDOT Existing ROW
- CU Site Boundary
- New Berm
- Detention Pond Area
- Boulder City Limits
- Preble's Critical Habitat
- Preble's Conservation Zone
- OSMP Wetland Riparian Data
- Effective 100 Year Floodplain
- Streams, Creeks and Ditches

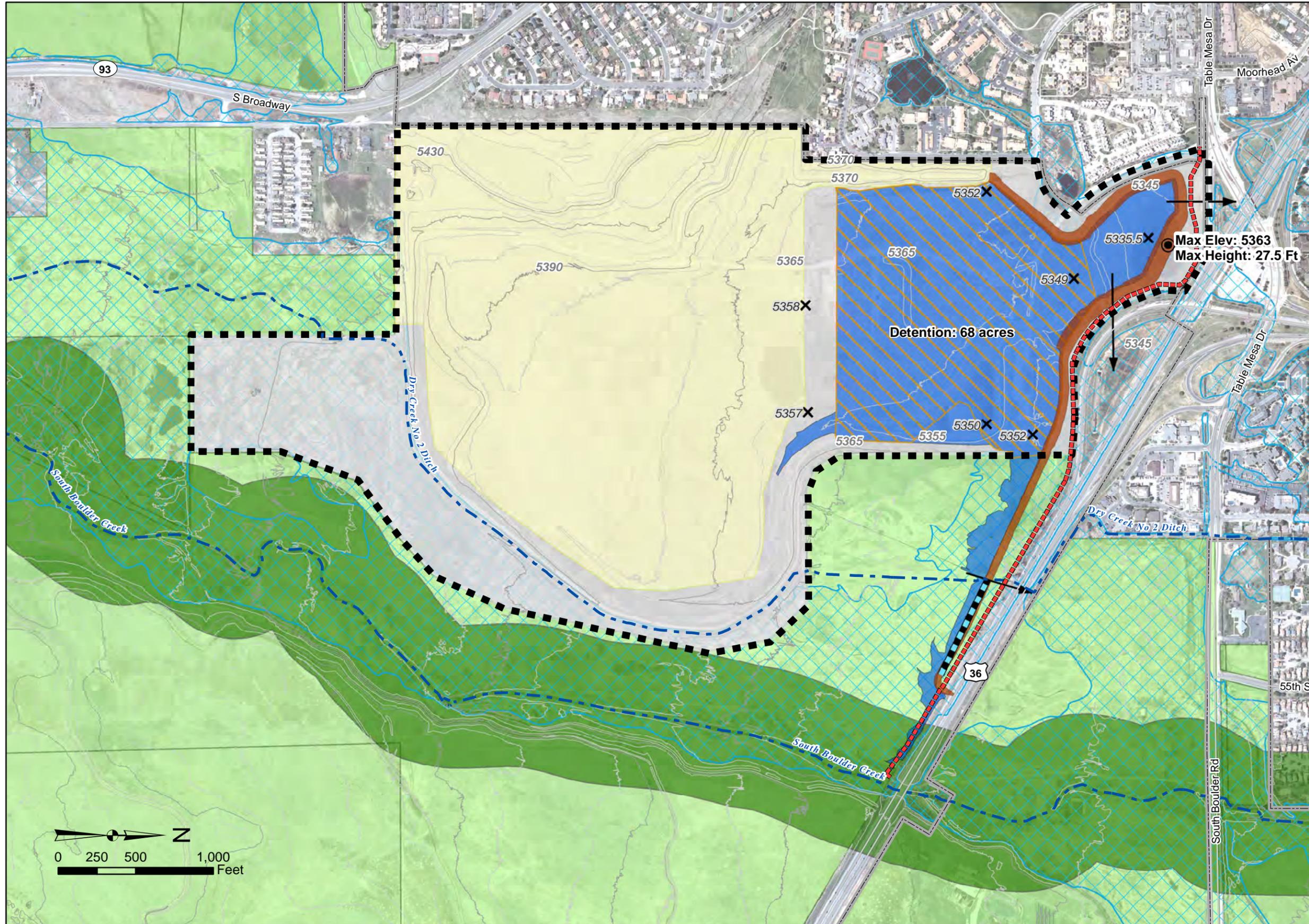
Option A: Proposed Berm
Approximate Maximum Width Base & Approximate Detention Pond Impacts to OSMP Land

South Boulder Creek Flood Mitigation Project



Stormwater Detention Upstream of US36

South Boulder Creek Flood Mitigation Project



Option B

- Single Berm
- With excavation
- No Fill
- On CU and OSMP property
- Max Berm Height 27.5ft
- Berm length shortened to avoid critical habitat

Description	Acres
Total CU Property	302
CU Property Impacted	90
CU Building Potential Impacted	36
OSMP Property Impacted	7

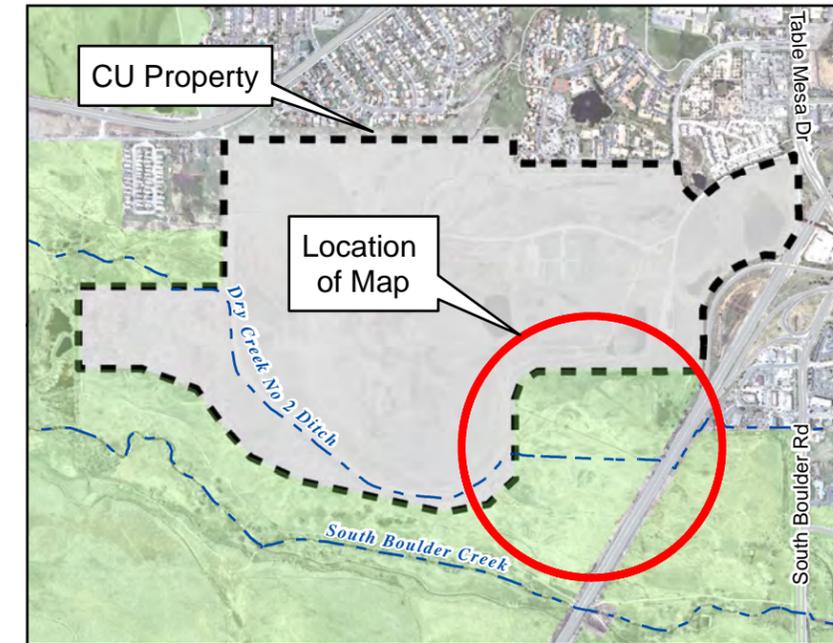
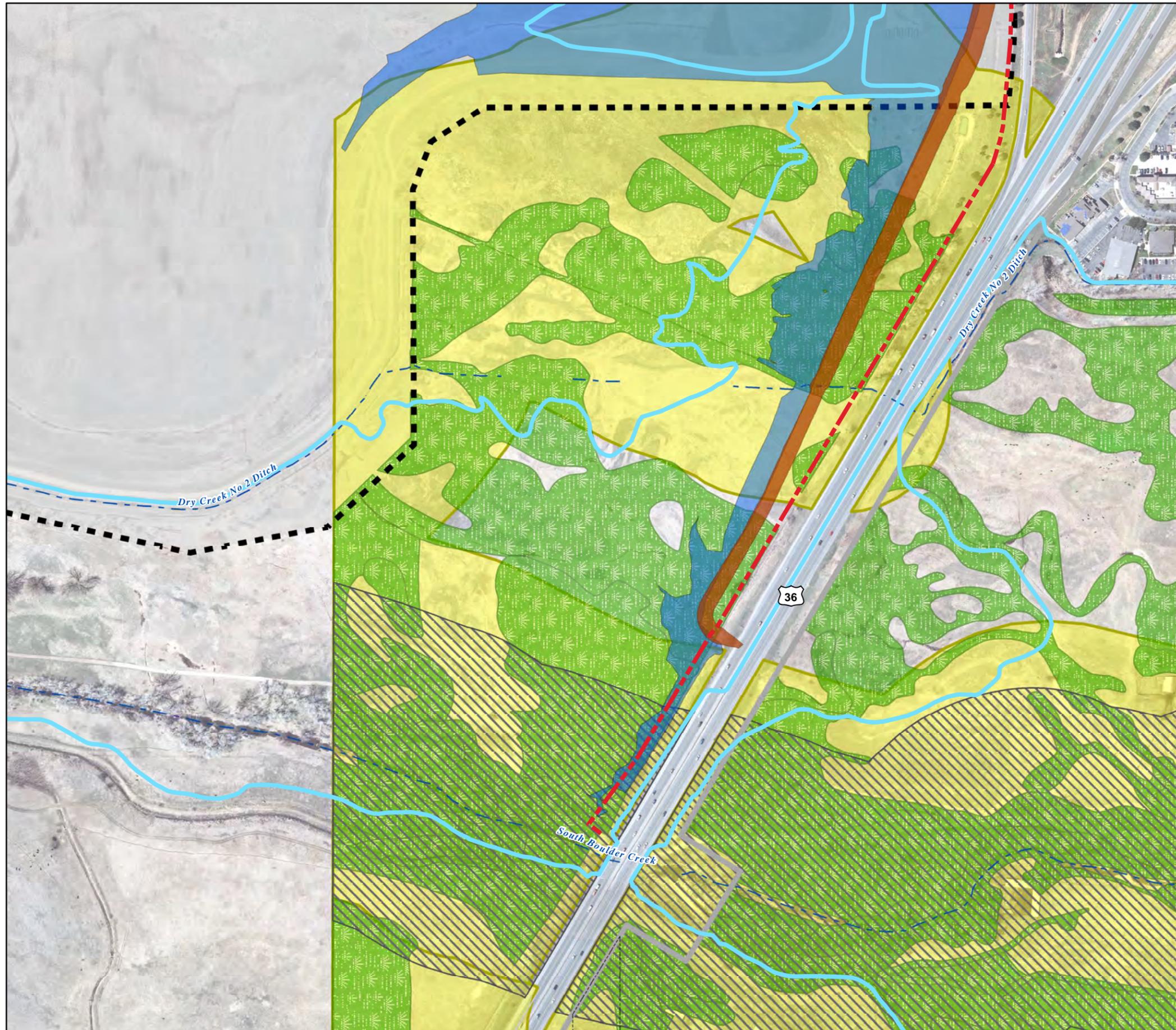
Proposed Conditions

- New Berm
- Pool Contained By Fill or Cut Slope
- Limits of Excavation
- Detention Pond Area
- Fill Area
- Out of 100yr Inundation
- X Spot Elevation
- Max Berm Elevation
- Discharge Location
- Spillway

Existing Conditions

- Boulder City Limits
- CDOT Existing ROW
- CU Site Boundary
- OSMP Property
- Prebles Critical Habitat Area
- Effective 100 Year Floodplain
- 5 Foot Contours
- 10 Foot Contours



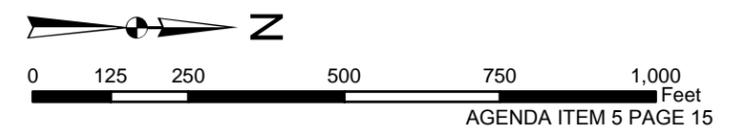


LEGEND

- CDOT Existing ROW
- CU Site Boundary
- New Berm
- Detention Pond Area
- Boulder City Limits
- Preble's Critical Habitat
- Preble's Conservation Zone
- OSMP Wetland Riparian Data
- Effective 100 Year Floodplain
- Streams, Creeks and Ditches

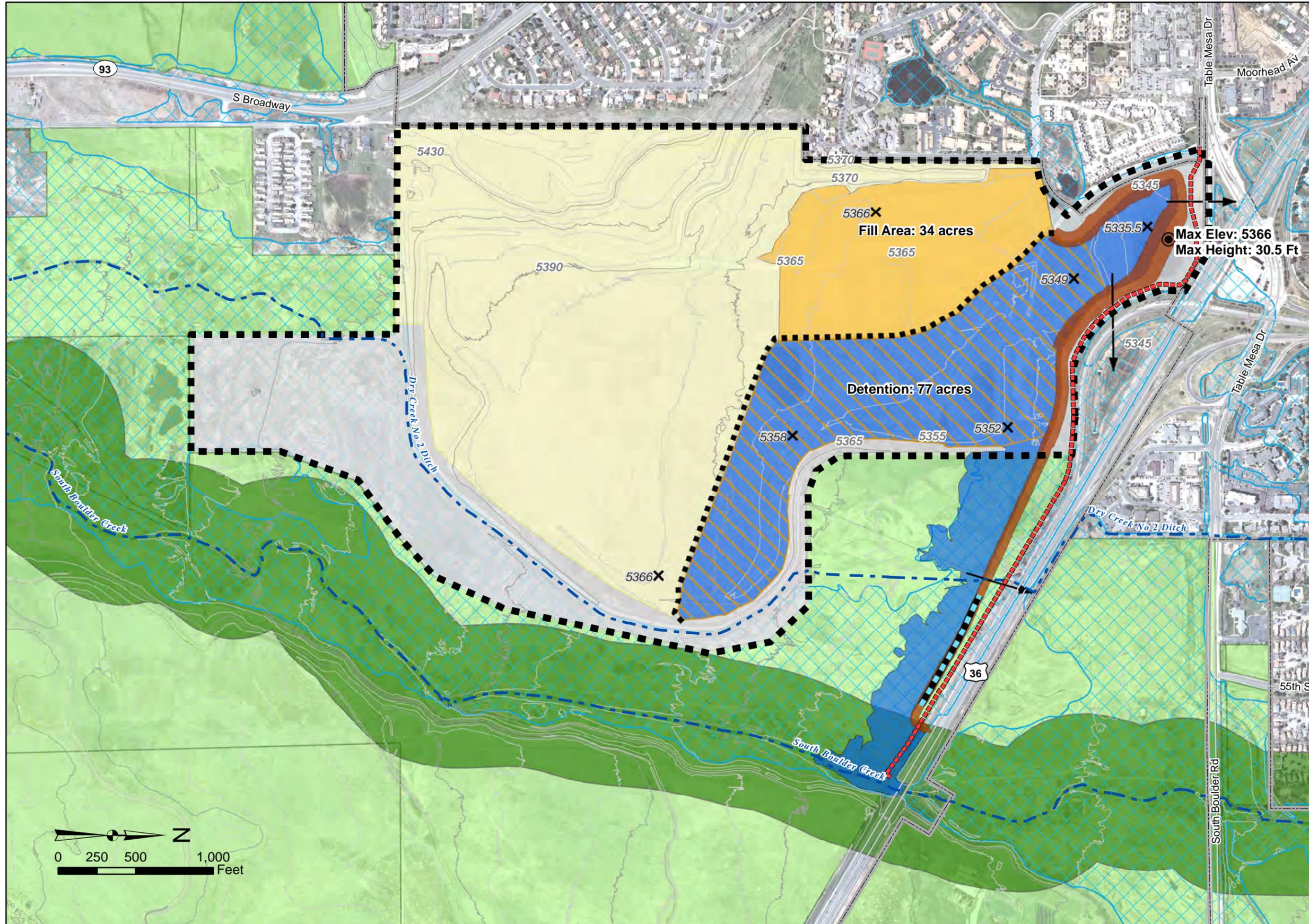
Option B: Proposed Berm
Approximate Maximum Width Base & Approximate Detention Pond Impacts to OSMP Land

South Boulder Creek Flood Mitigation Project



Stormwater Detention Upstream of US36

South Boulder Creek Flood Mitigation Project



Option C

Single Berm
 With excavation
 With fill
 On CU and OSMP property
 Max Berm Height 30.5ft

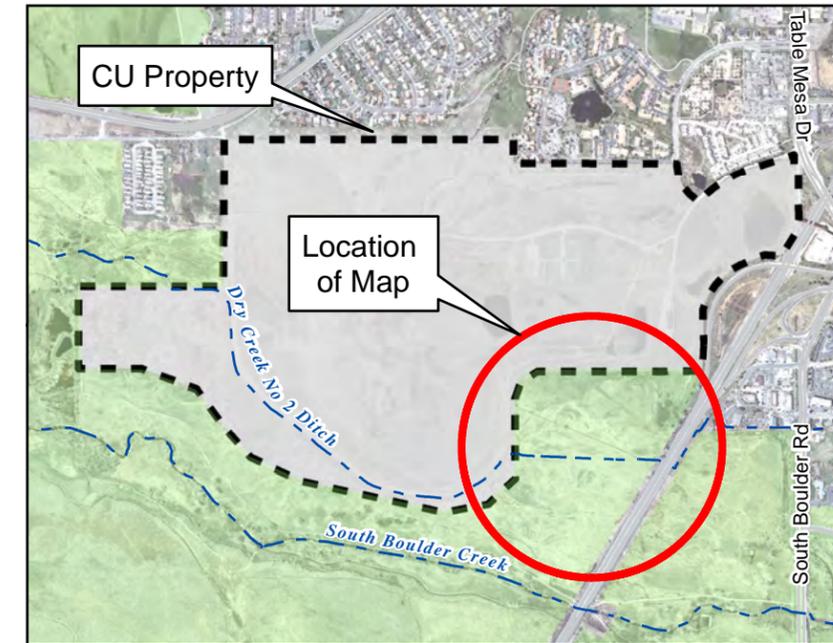
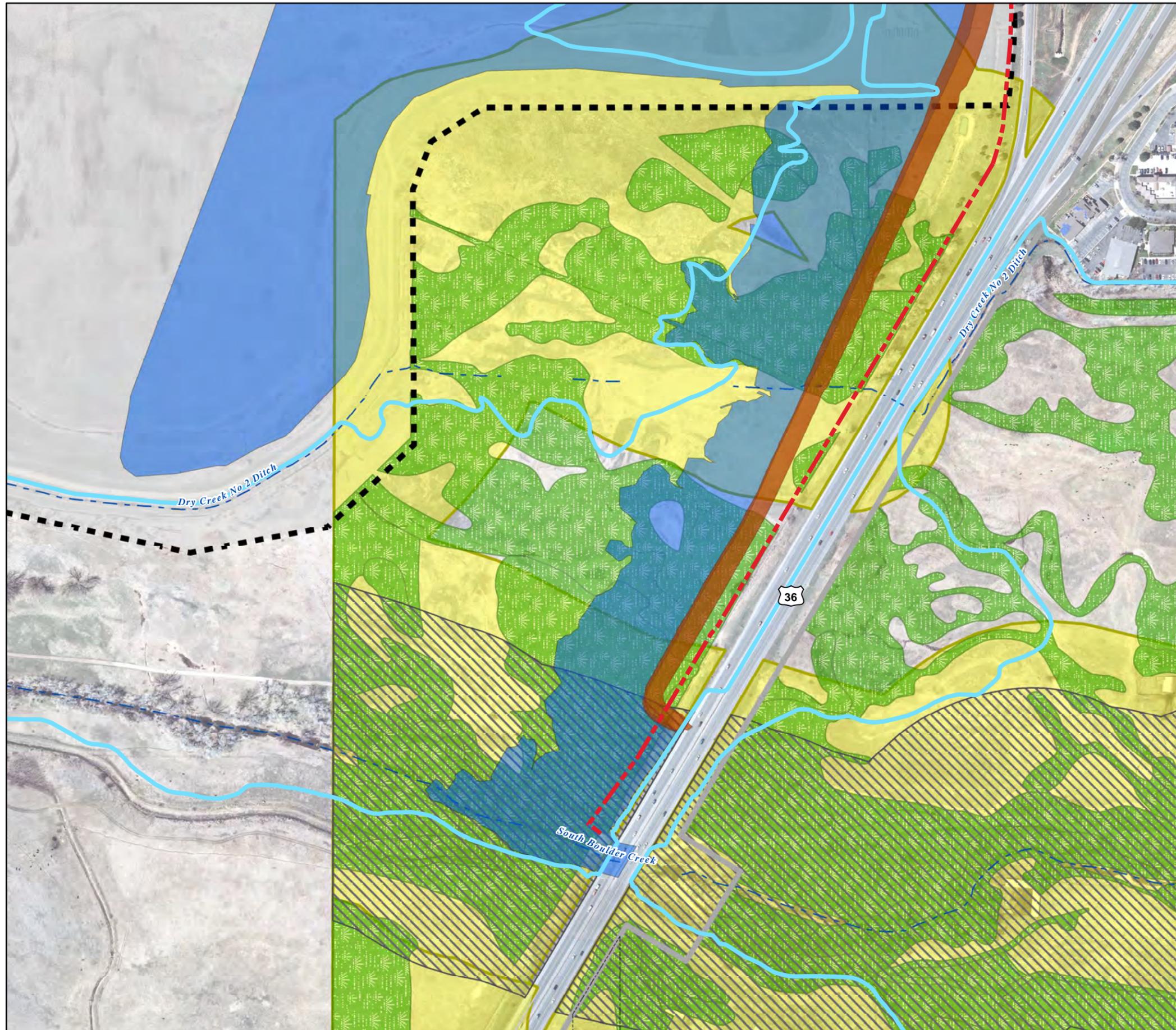
Description	Acres
Total CU Property	302
CU Property Impacted	80
CU Building Potential Impacted	30
OSMP Property Impacted	20

Proposed Conditions

- New Berm
- Pool Contained By Fill or Cut Slope
- Limits of Excavation
- Detention Pond Area
- Fill Area
- Out of 100yr Inundation
- Spot Elevation
- Max Berm Elevation
- Discharge Location
- Spillway

Existing Conditions

- Boulder City Limits
- CDOT Existing ROW
- CU Site Boundary
- OSMP Property
- Prebles Critical Habitat Area
- Effective 100 Year Floodplain
- 5 Foot Contours
- 10 Foot Contours



LEGEND

-  CDOT Existing ROW
-  CU Site Boundary
-  New Berm
-  Detention Pond Area
-  Boulder City Limits
-  Preble's Critical Habitat
-  Preble's Conservation Zone
-  OSMP Wetland Riparian Data
-  Effective 100 Year Floodplain
-  Streams, Creeks and Ditches

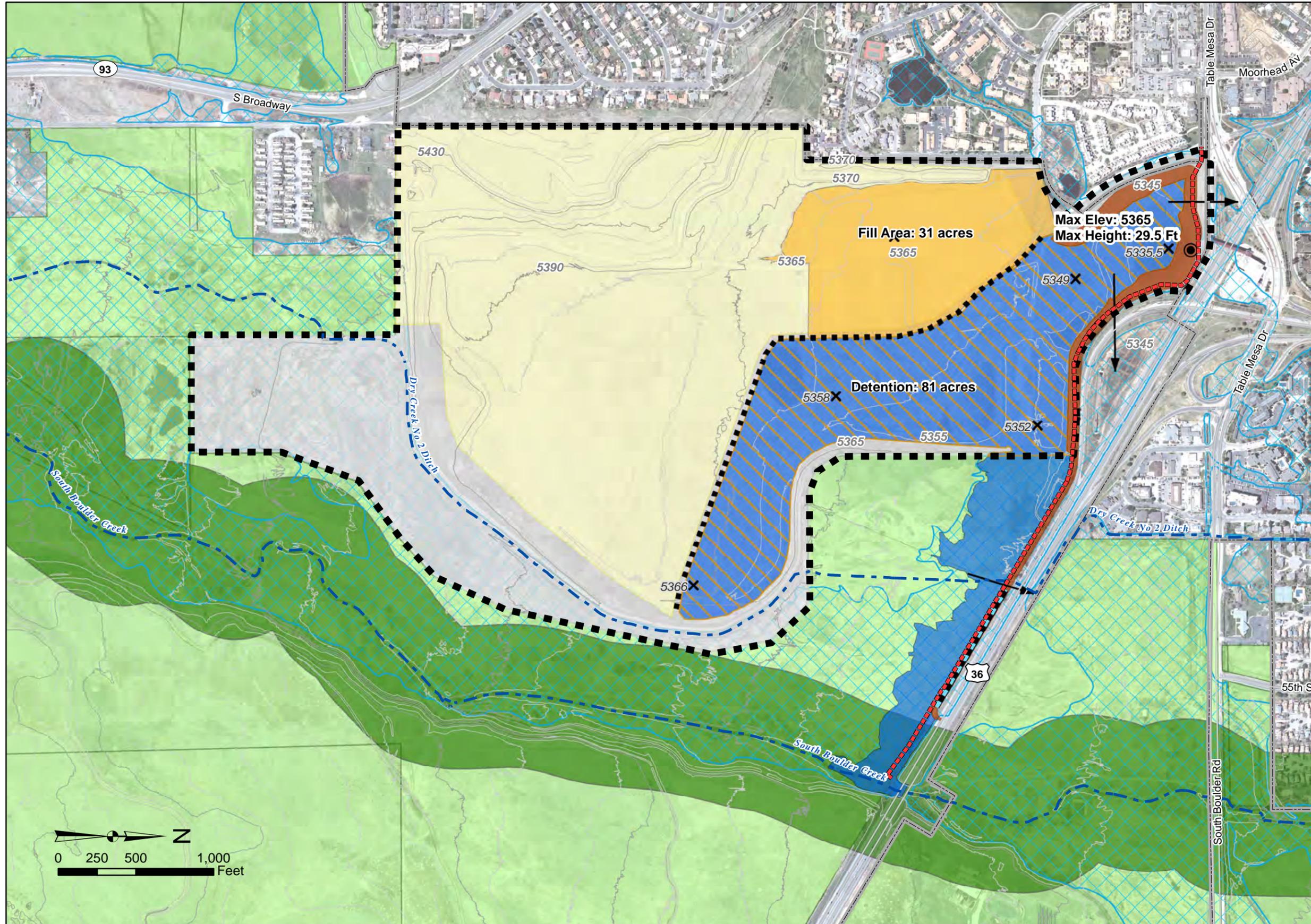
Option C: Proposed Berm
Approximate Maximum Width Base & Approximate Detention Pond Impacts to OSMP Land

South Boulder Creek Flood Mitigation Project



Stormwater Detention Upstream of US36

South Boulder Creek Flood Mitigation Project



Option D

Single Berm
 With excavation
 With fill
 On CU and OSMP property
 In CDOT Existing ROW
 Max Berm Height 29.5ft

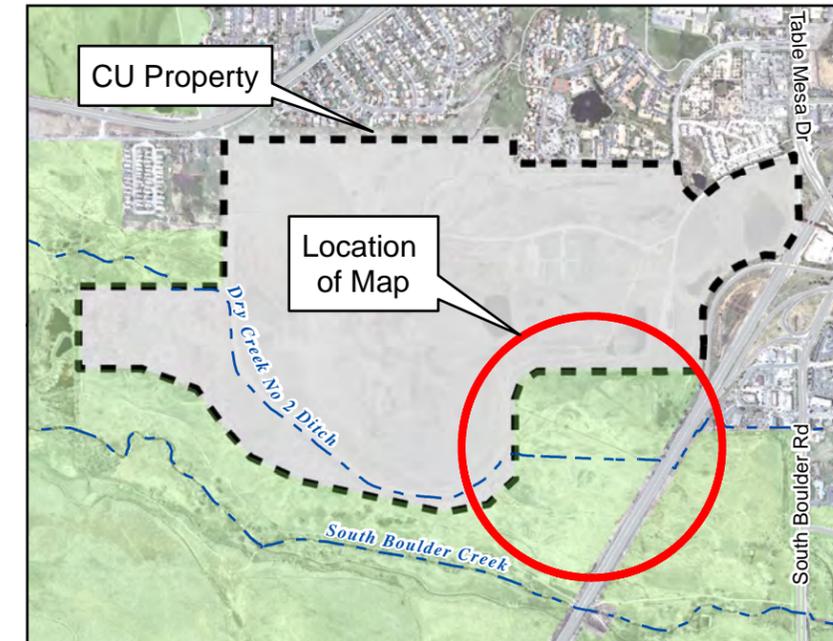
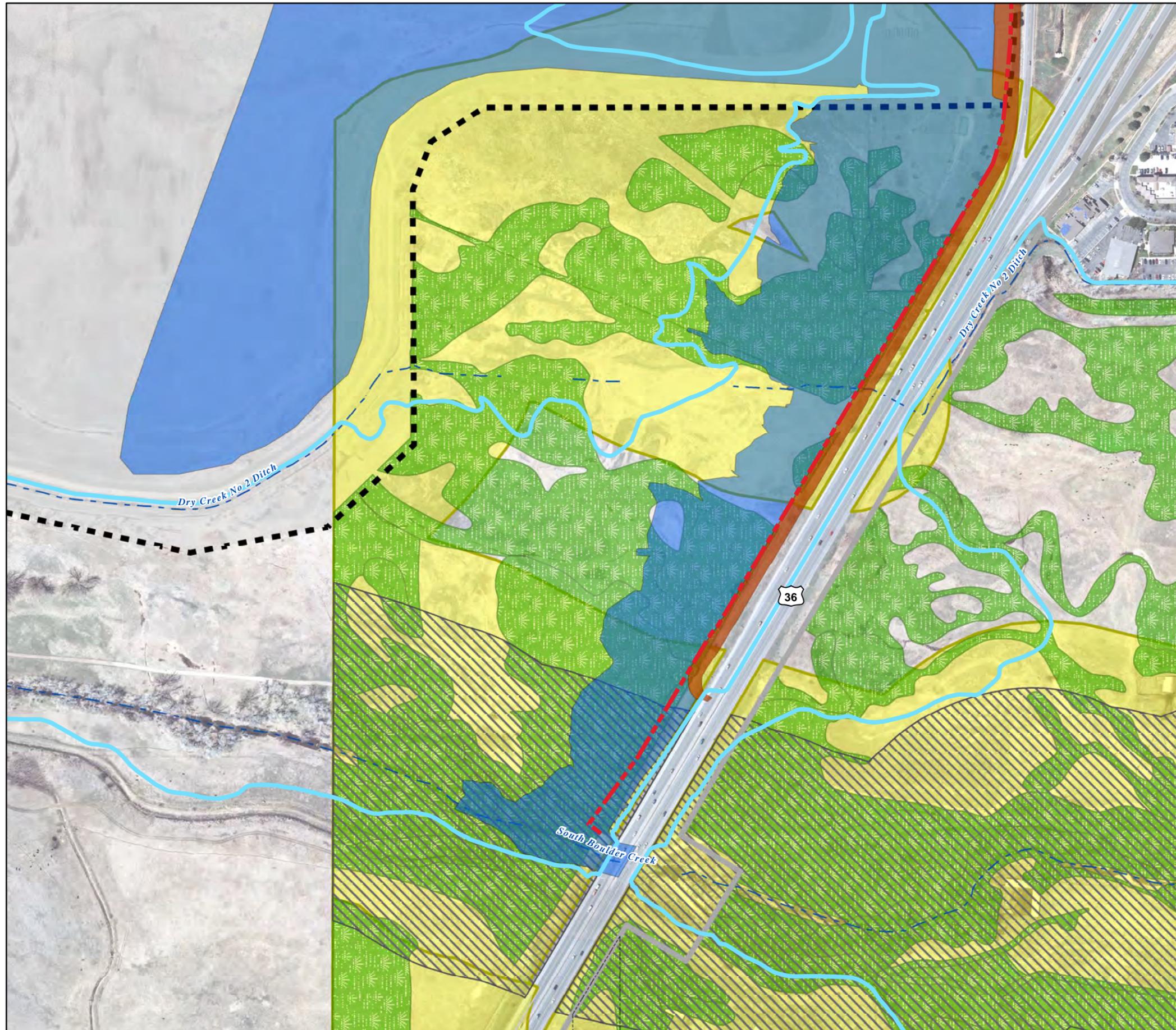
Description	Acres
Total CU Property	302
CU Property Impacted	78
CU Building Potential Impacted	30
OSMP Property Impacted	19

Proposed Conditions

- New Berm
- Pool Contained By Fill or Cut Slope
- Limits of Excavation
- Detention Pond Area
- Fill Area
- Out of 100yr Inundation
- ✕ Spot Elevation
- Max Berm Elevation
- Discharge Location
- Spillway

Existing Conditions

- Boulder City Limits
- CDOT Existing ROW
- CU Site Boundary
- OSMP Property
- Prebles Critical Habitat Area
- Effective 100 Year Floodplain
- 5 Foot Contours
- 10 Foot Contours

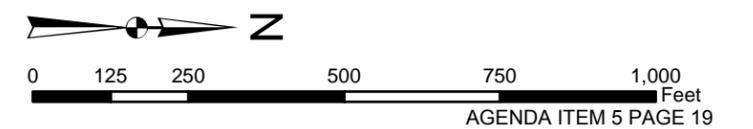


LEGEND

- CDOT Existing ROW
- CU Site Boundary
- New Berm
- Detention Pond Area
- Boulder City Limits
- Preble's Critical Habitat
- Preble's Conservation Zone
- OSMP Wetland Riparian Data
- Effective 100 Year Floodplain
- Streams, Creeks and Ditches

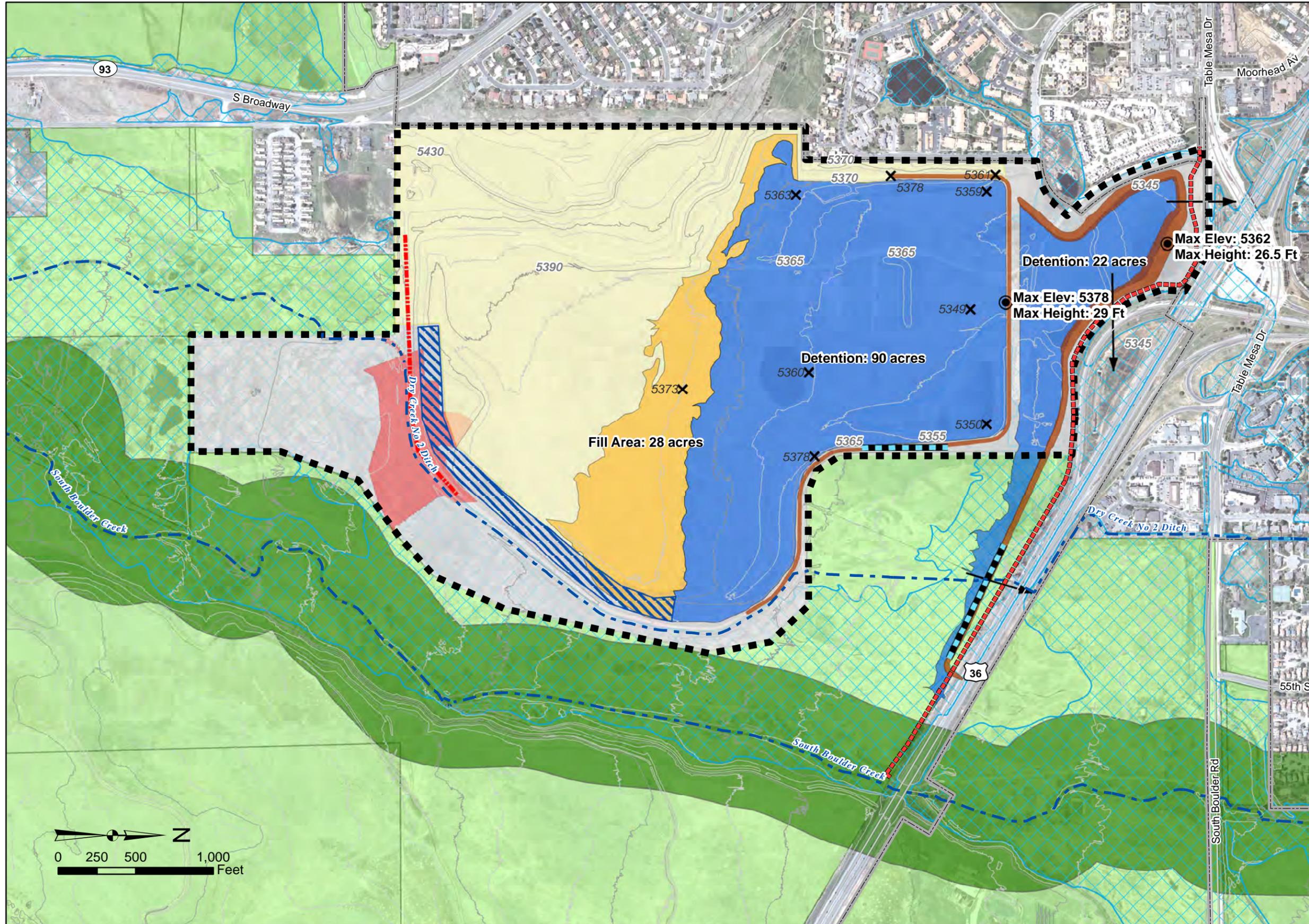
Option D: Proposed Berm
Approximate Maximum Width Base & Approximate Detention Pond Impacts to OSMP Land

South Boulder Creek Flood Mitigation Project



Stormwater Detention Upstream of US36

South Boulder Creek Flood Mitigation Project



Option E

- Dual Berm
- No Excavation
- No Fill
- On CU and OSMP property
- Max Berm Height 29ft and 26.5ft

Description	Acres
Total CU Property	302
CU Property Impacted	142
CU Building Potential Impacted	73
OSMP Property Impacted	5

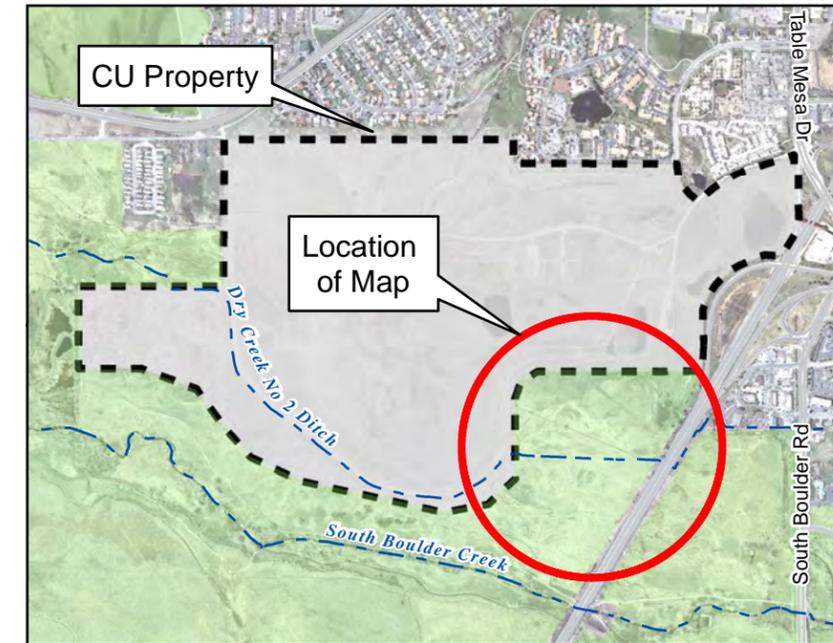
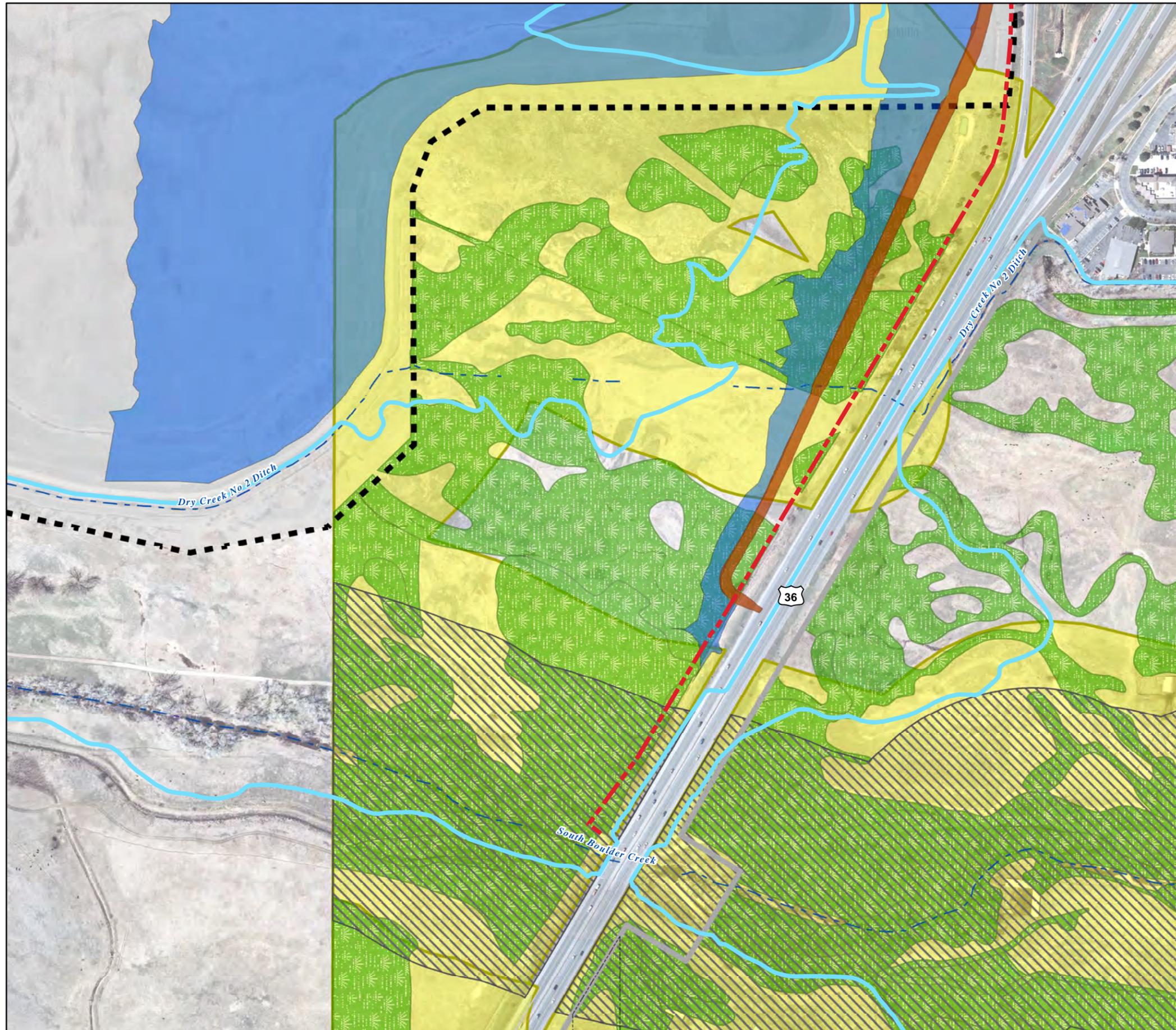
Proposed Conditions

- New Berm
- Limits of Excavation
- Detention Pond Area
- Fill Area
- New Channel
- Remove Existing Berm
- Lower Grade (Allows Flow to Pond)
- Out of 100yr Inundation
- X Spot Elevation
- Max Berm Elevation
- Discharge Location
- Spillway

Existing Conditions

- Boulder City Limits
- CDOT Existing ROW
- CU Site Boundary
- OSMP Property
- Prebles Critical Habitat Area
- Effective 100 Year Floodplain
- 5 Foot Contours
- 10 Foot Contours



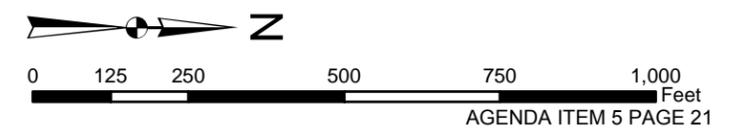


LEGEND

- CDOT Existing ROW
- CU Site Boundary
- New Berm
- Detention Pond Area
- Boulder City Limits
- Preble's Critical Habitat
- Preble's Conservation Zone
- OSMP Wetland Riparian Data
- Effective 100 Year Floodplain
- Streams, Creeks and Ditches

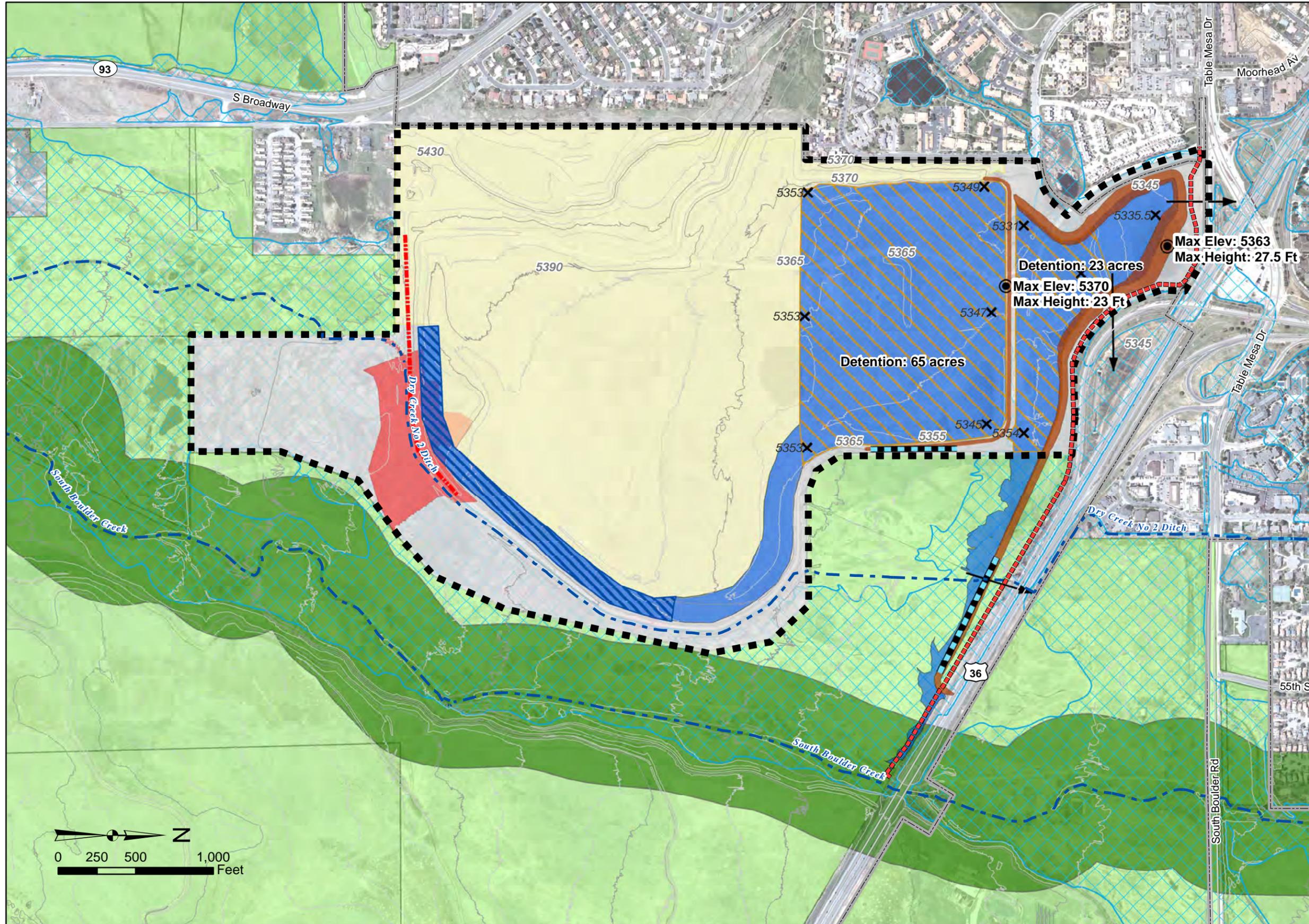
Option E: Proposed Berm
Approximate Maximum Width Base & Approximate Detention Pond Impacts to OSMP Land

South Boulder Creek Flood Mitigation Project



Stormwater Detention Upstream of US36

South Boulder Creek Flood Mitigation Project



Option F

- Dual Berm
- With Excavation
- No Fill
- On CU and OSMP property
- Max Berm Height 23ft and 27.5ft

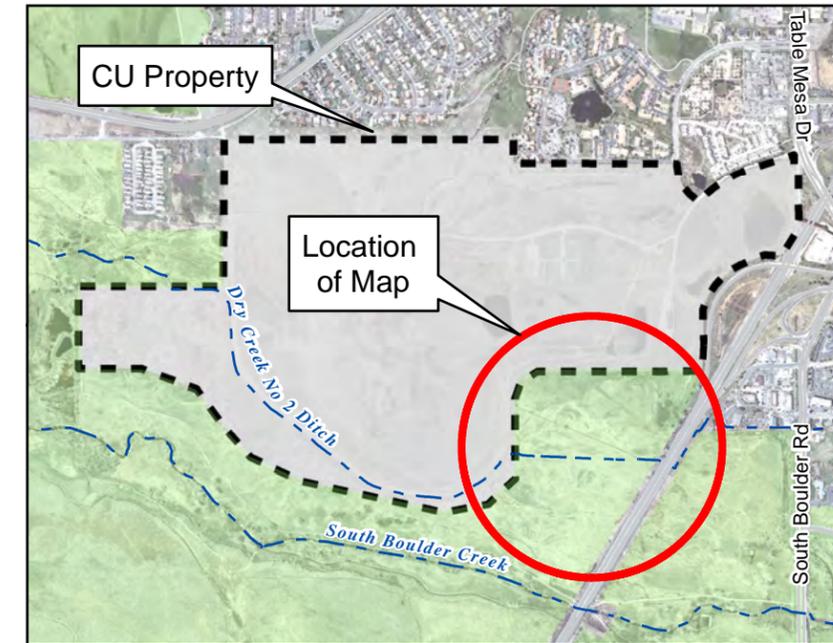
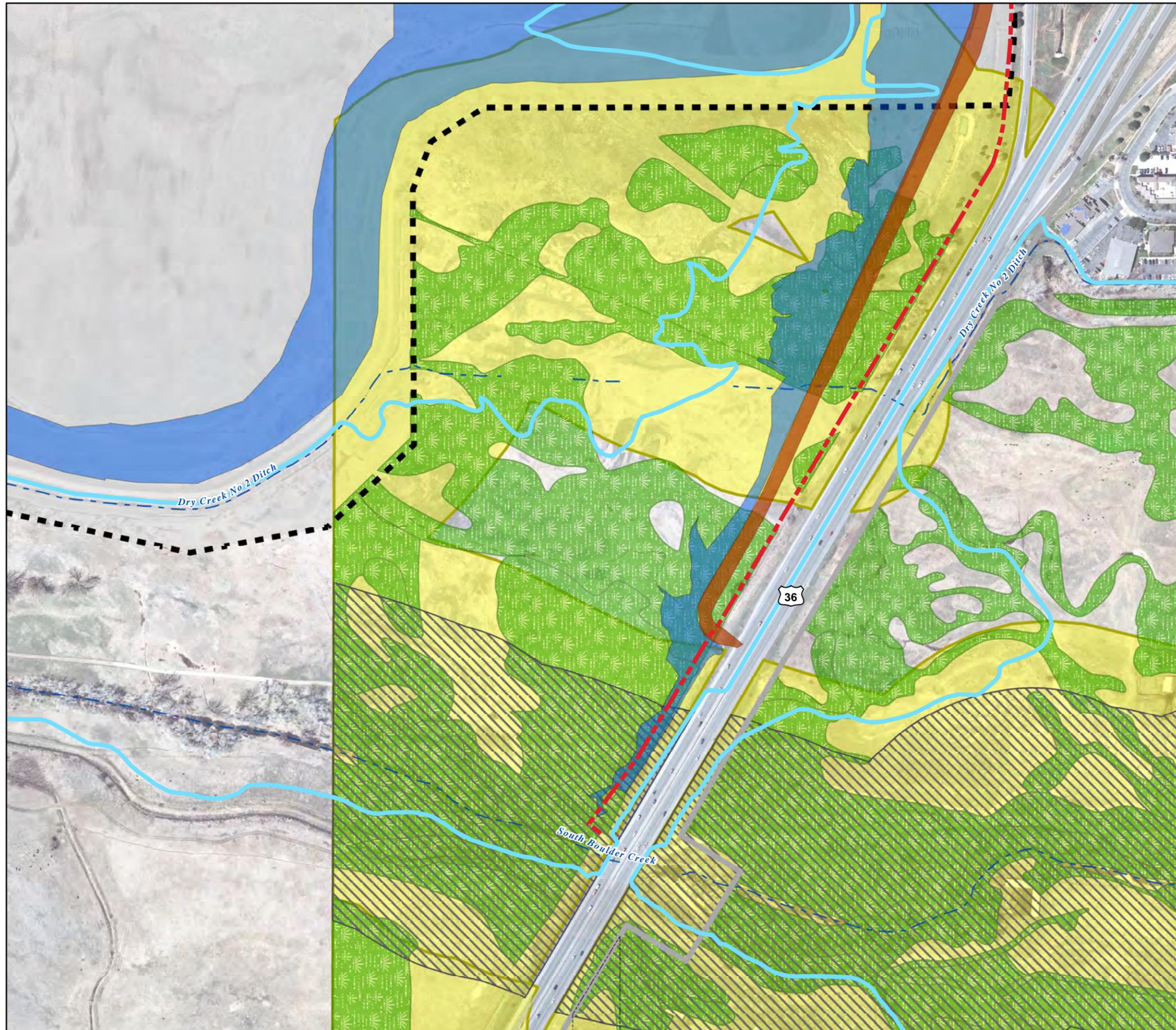
Description	Acres
Total CU Property	302
CU Property Impacted	100
CU Building Potential Impacted	41
OSMP Property Impacted	7

Proposed Conditions

- New Berm
- Limits of Excavation
- Detention Pond Area
- Fill Area
- ▨ New Channel
- Remove Existing Berm
- Lower Grade (Allows Flow to Pond)
- Out of 100yr Inundation
- ✕ Spot Elevation
- ⊙ Max Berm Elevation
- ➔ Discharge Location
- Spillway

Existing Conditions

- Boulder City Limits
- CDOT Existing ROW
- CU Site Boundary
- OSMP Property
- Prebles Critical Habitat Area
- Effective 100 Year Floodplain
- 5 Foot Contours
- 10 Foot Contours



LEGEND

- CDOT Existing ROW
- CU Site Boundary
- New Berm
- Detention Pond Area
- Boulder City Limits
- Preble's Critical Habitat
- Preble's Conservation Zone
- OSMP Wetland Riparian Data
- Effective 100 Year Floodplain
- Streams, Creeks and Ditches

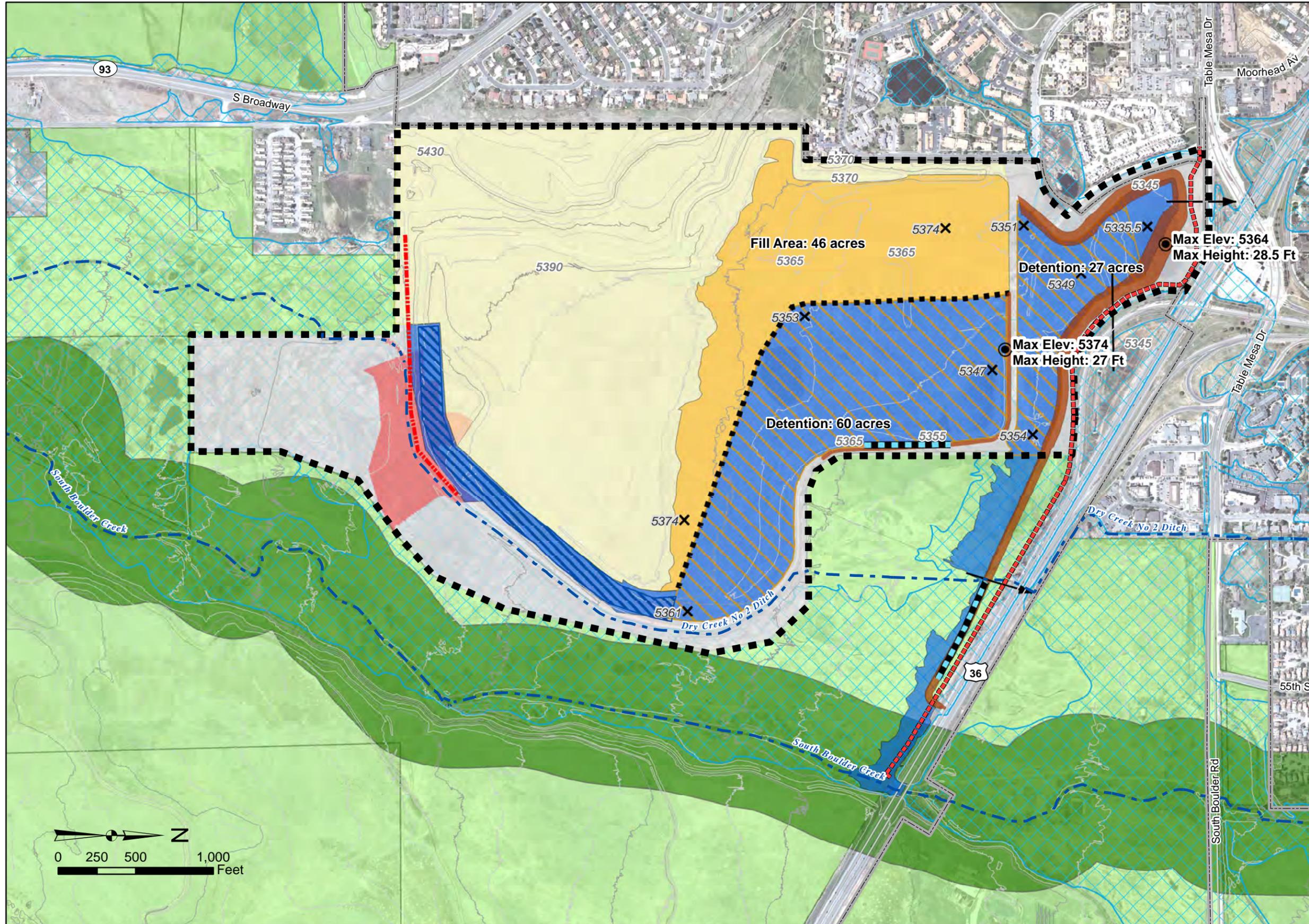
Option F: Proposed Berm
Approximate Maximum Width Base & Approximate Detention Pond Impacts to OSMP Land

South Boulder Creek Flood Mitigation Project



Stormwater Detention Upstream of US36

South Boulder Creek Flood Mitigation Project



Option G

Dual Berm
 With Excavation
 With fill
 On CU and OSMP property
 Max Berm Height 27ft and 28.5ft

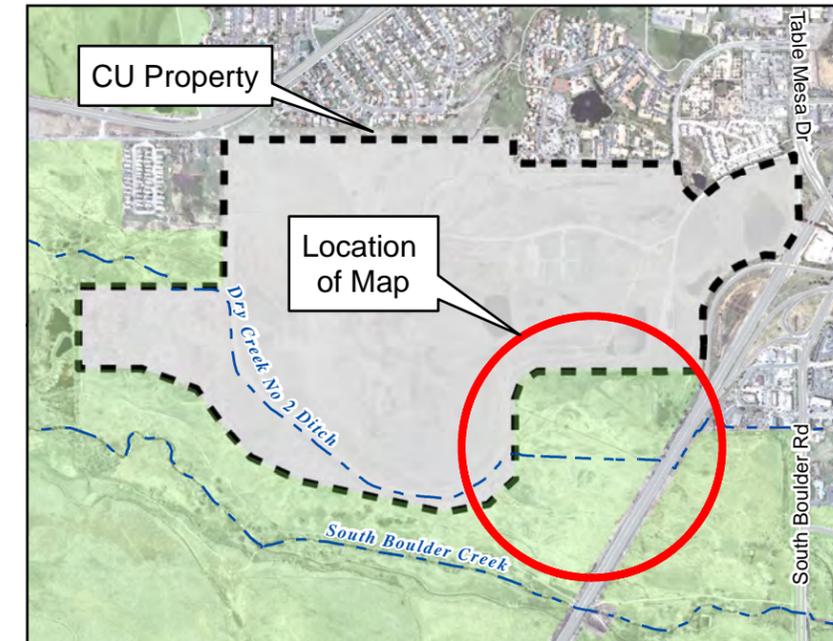
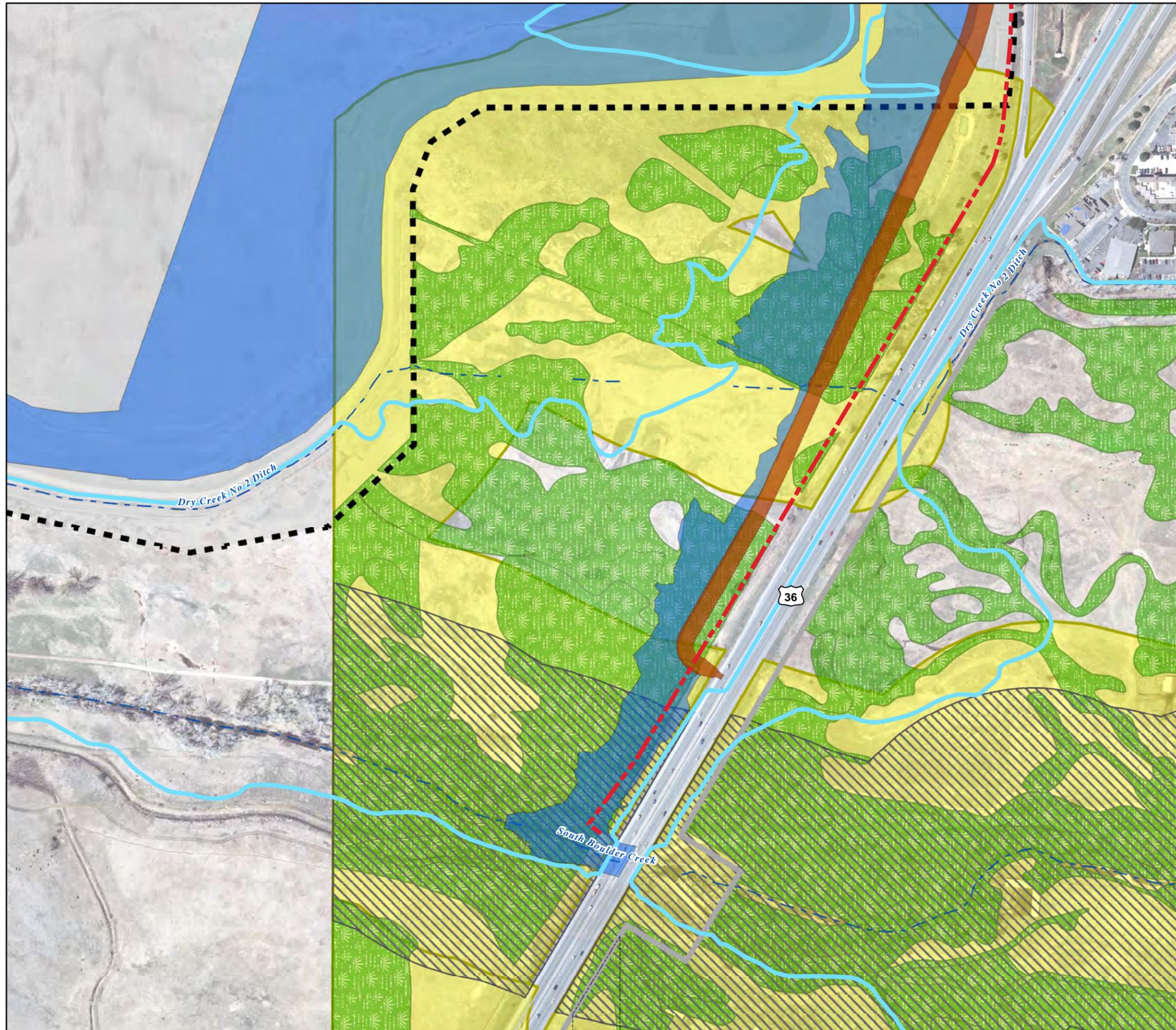
Description	Acres
Total CU Property	302
CU Property Impacted	99
CU Building Potential Impacted	43
OSMP Property Impacted	11

Proposed Conditions

- New Berm
- Pool Contained By Fill or Cut Slope
- Limits of Excavation
- Detention Pond Area
- Fill Area
- New Channel
- Remove Existing Berm
- Lower Grade (Allows Flow to Pond)
- Out of 100yr Inundation
- X Spot Elevation
- Max Berm Elevation
- Discharge Location
- Spillway

Existing Conditions

- Boulder City Limits
- CDOT Existing ROW
- CU Site Boundary
- OSMP Property
- Prebles Critical Habitat Area
- Effective 100 Year Floodplain
- 5 Foot Contours
- 10 Foot Contours



LEGEND

- CDOT Existing ROW
- CU Site Boundary
- New Berm
- Detention Pond Area
- Boulder City Limits
- Preble's Critical Habitat
- Preble's Conservation Zone
- OSMP Wetland Riparian Data
- Effective 100 Year Floodplain
- Streams, Creeks and Ditches

Option G: Proposed Berm
Approximate Maximum Width Base & Approximate Detention Pond Impacts to OSMP Land

South Boulder Creek Flood Mitigation Project

