Welcome!

The purpose of this meeting is to:

- Discuss the status of the Ames Flood Mitigation Study
- Discuss the initial screening criteria
- Present the results of the initial screening of alternatives and strategies
- Continue to gather feedback on flooding issues and mitigation strategies

Evaluation Process

The Study

Method

Collect public input, develop and analyze alternatives and strategies, summarize impacts.

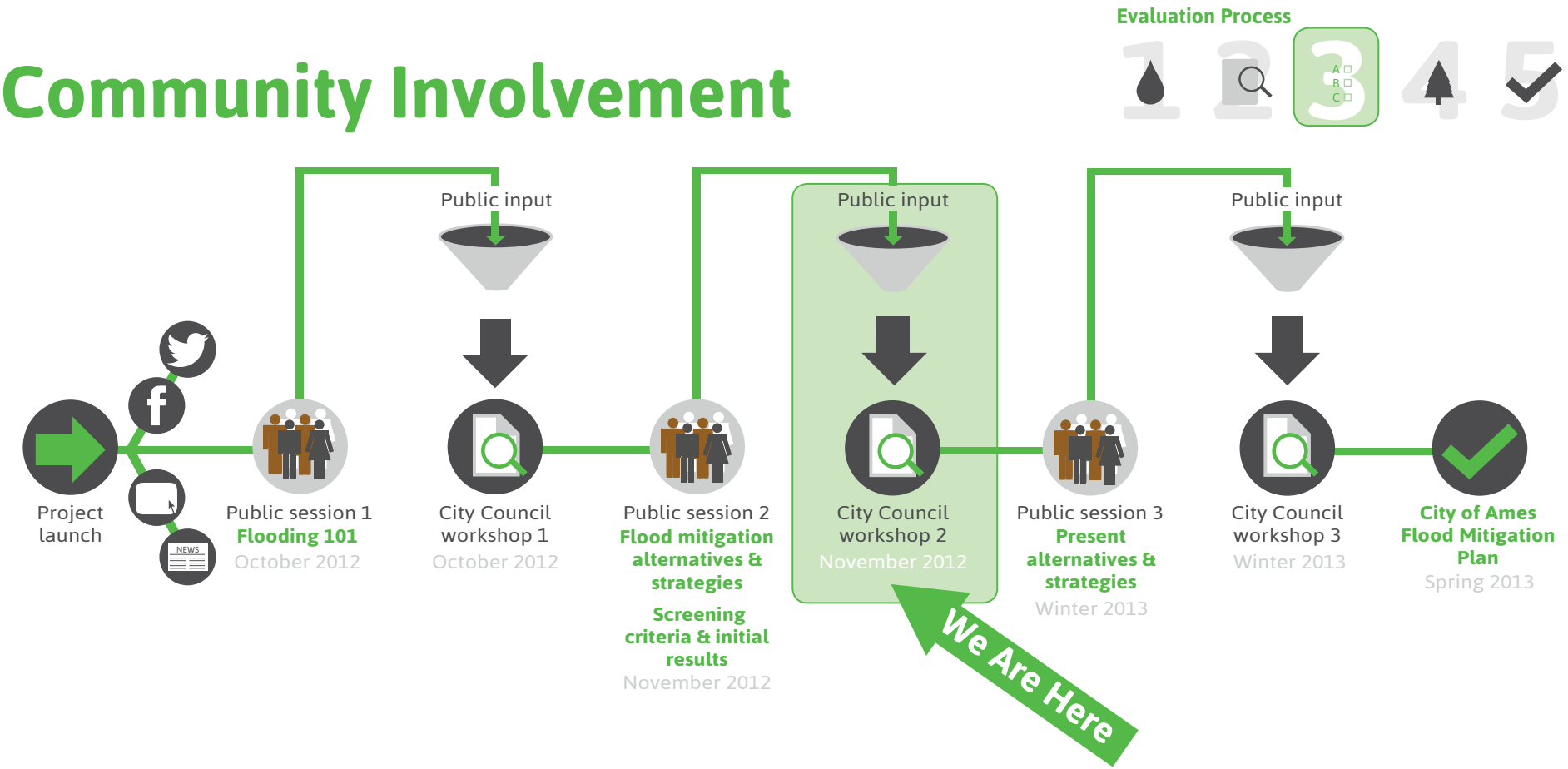
Focus

Determine impacts—positive and negative—of flood mitigation alternatives and strategies.

Goal

Present the best alternatives and strategies to City Council.

Community Involvement



Website Visits	866 visits
Online Meeting Participation	151 attendees*
Public Session 1 Meeting Attendance	98 attendees
Public Session 2 Meeting Attendance	58 attendees
Comments Received	120 comments

**Public Session 2 Online Meeting Attendance not included.*

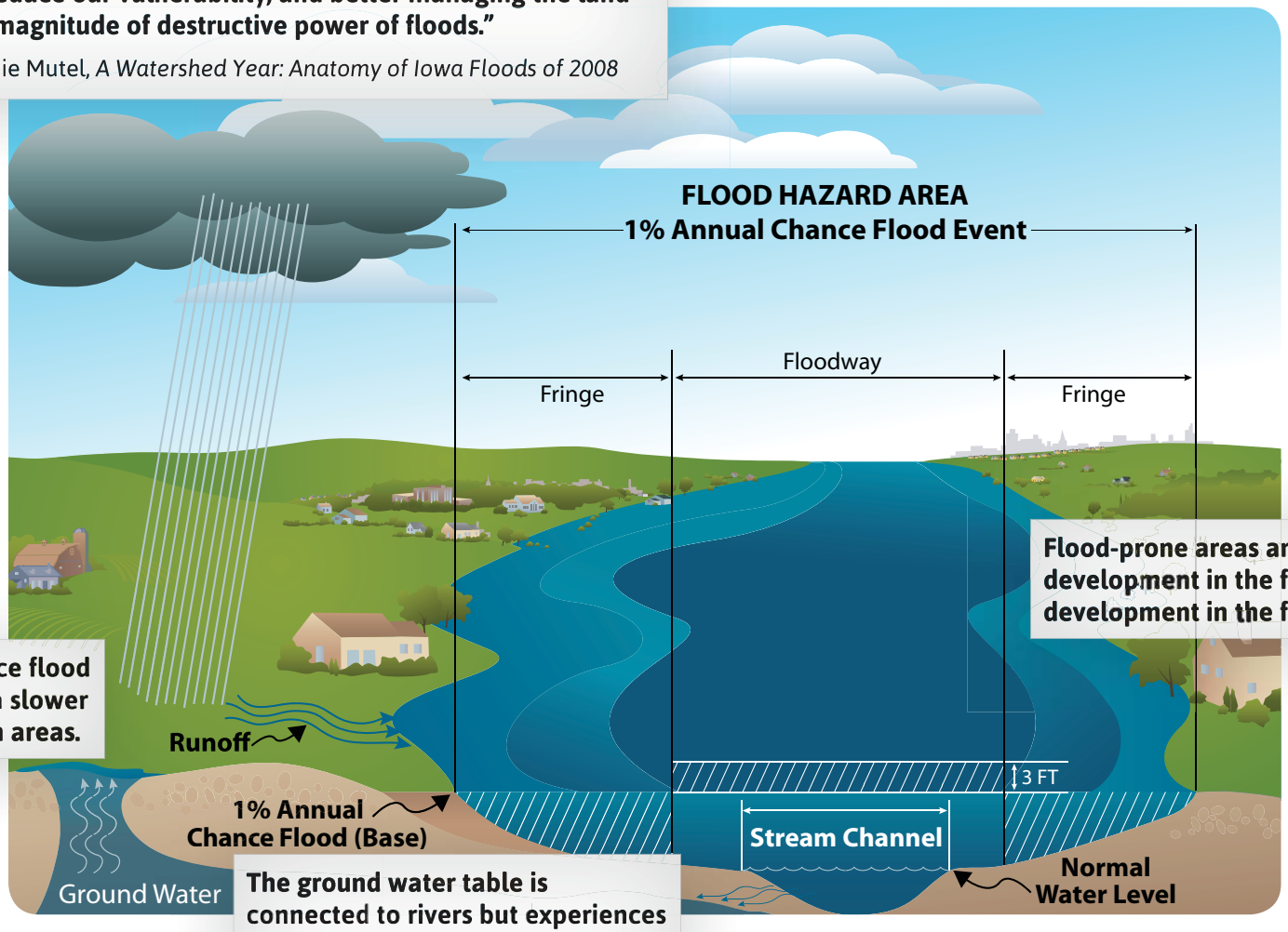
Evaluation Process

What Did We Hear at Public Session 2?

- 100 year flood data is ineffective
- Consider environmental impacts
- Consider dredging creeks while dry
- Consider upstream containment structures
- Consider conservation measures
- Consider floodplain ordinance modifications for all alternatives and strategies
- Better emergency management
- Listen to impacted parties

"Living with floods involves two broad activities: better managing the risks and taking steps to reduce our vulnerability, and better managing the landscape to reduce the magnitude of destructive power of floods."

--Connie Mutel, *A Watershed Year: Anatomy of Iowa Floods of 2008*



Rural areas produce flood causing runoff at a slower rate than do urban areas.

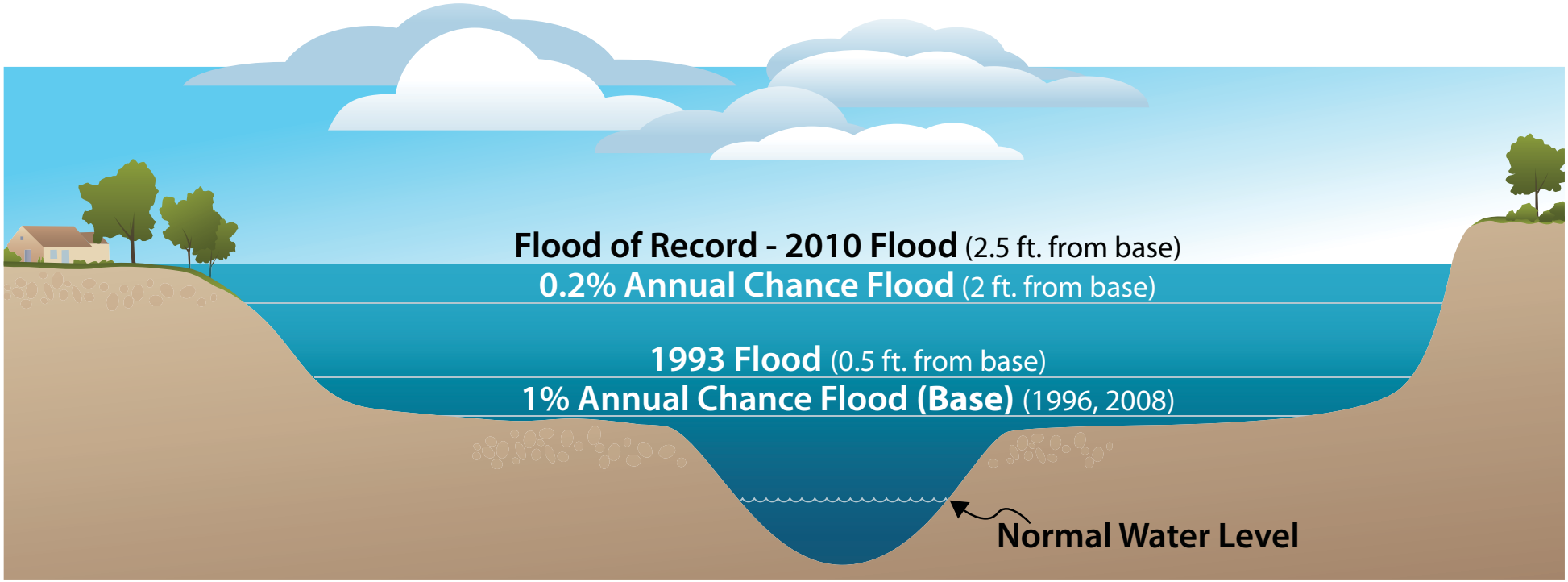
Flood-prone areas are managed by restricting development in the floodway, but allowing development in the floodway fringe.

The ground water table is connected to rivers but experiences a delayed response to flood waters. Ground water rises in a flood event.

Evaluation Process

1 2 3 4 5

Flooding 101



River Cross Section at Skunk River (below confluence with Squaw Creek)

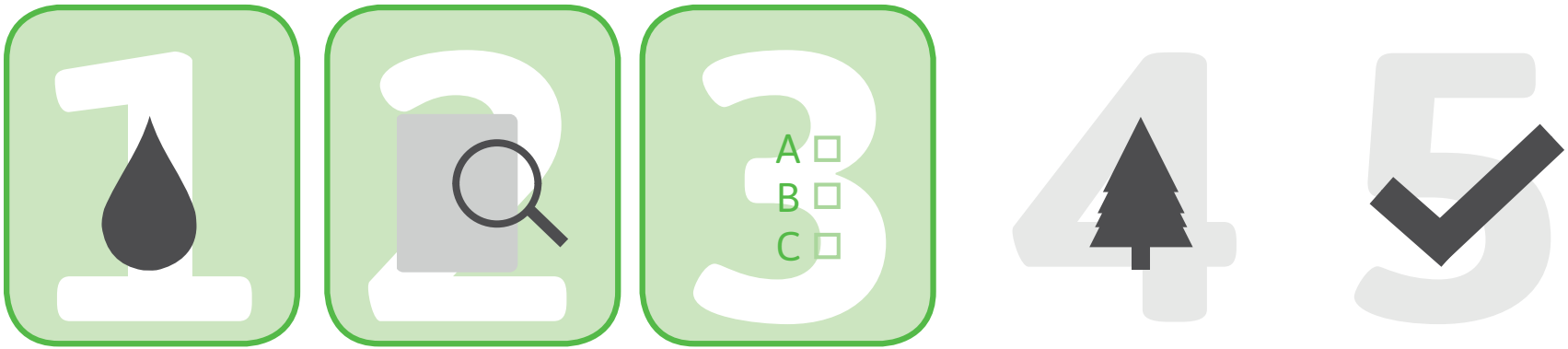
Evaluation Process

Flood Hydrology

The study team updated flood magnitudes and frequencies by engineering and statistical calculations and reviewed and updated flood maps.

USGS Gage	Source	Annual flood-probability discharge (cfs)			
		10-percent	2-percent	1-percent	0.2-percent
South Skunk River near Ames, IA	Updated FFA	6,800	10,200	11,600	14,900
	FEMA Effective Flows	6,280	9,000	10,100	12,600
Squaw Creek at Ames, IA	Updated FFA	8,260	15,800	20,000	32,600
	FEMA Effective Flows	7,570	13,700	17,000	26,300
South Skunk River below Squaw Creek near Ames, IA	Updated FFA	14,500	24,100	28,900	41,800
	FEMA Effective Flows	12,700	19,700	23,000	31,400

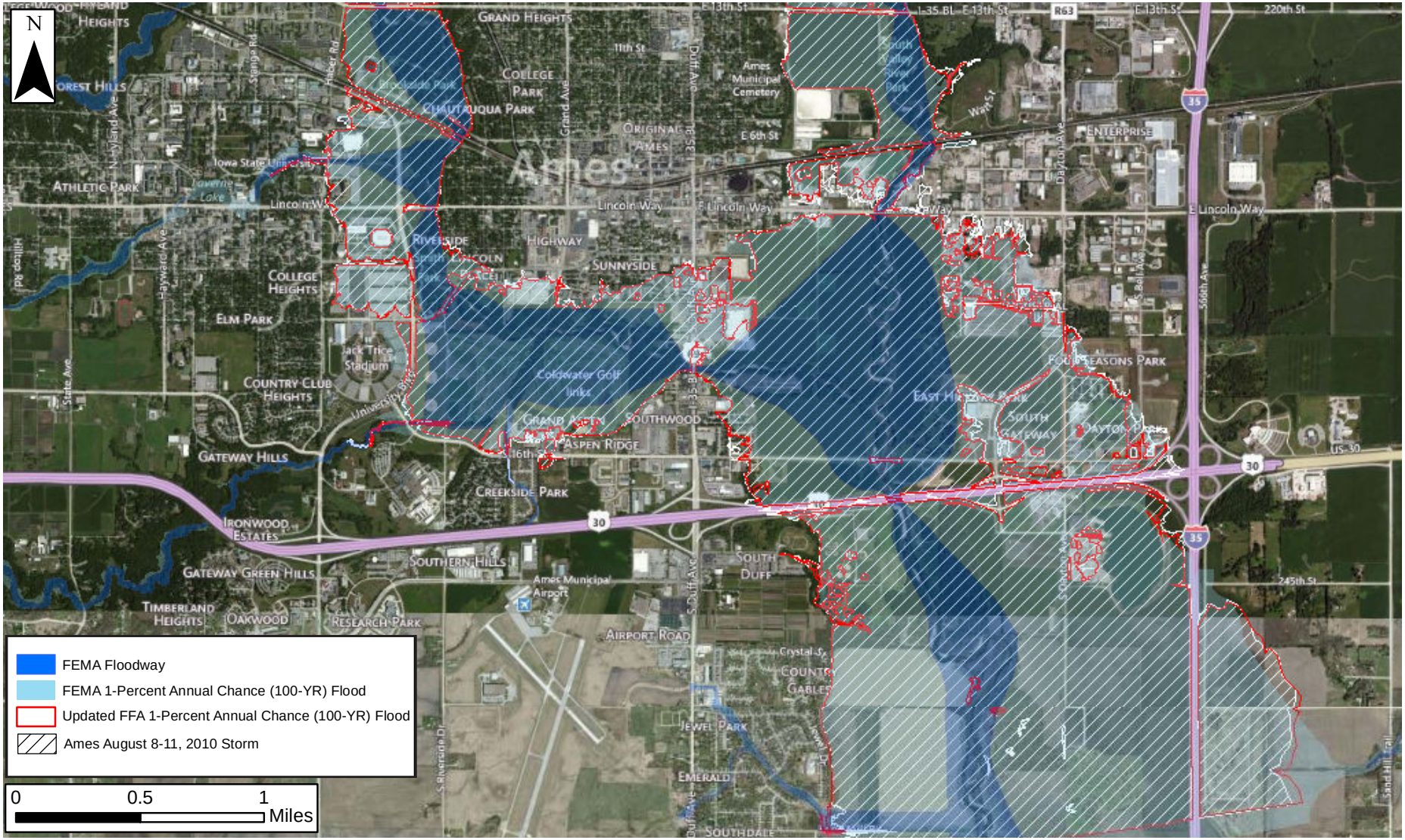
Evaluation Process



Since we last met in October, we have:

- Updated flood hydrology in the greater Ames community
- Developed initial flood mitigation screening criteria
- Evaluated preliminary flood mitigation alternatives and strategies
- Considered, reviewed and incorporated public input on potential flooding solutions

1% Annual Chance FEMA Floodplain, 1% Annual Chance Updated FFA Floodplain and Ames August 8-11, 2010 Flood Extent



Confluence of Squaw Creek and Skunk River

* Approximate boundaries based on modeled inundation not actual inundation from the 2012 flood event

1% Annual Chance FEMA Floodplain, 1% Annual Chance Updated FFA Floodplain and Ames August 8-11, 2010 Flood Extent

Squaw Creek and Skunk River

* Approximate boundaries based on modeled inundation not actual inundation from the 2012 flood event

Evaluation Process

Transposed Rainstorms

- **Upper Iowa River, Iowa, June 7-8, 2008**
  10.5 inches in 30 hours
- **Ames, Iowa, August 8-11, 2010**
  10 inches
- **Lake Delhi, Iowa, Dam Failure Event, July 24, 2010**
  13 inches in 48 hours
- **Ames, Iowa, August 8-11, 2010**
  with Transposed 2nd Night of Rainfall
  20% more rainfall
- **Dubuque, Iowa (Galena, Illinois), July 27-28, 2011**
  11+ inches of rain in 13 hours, 0.1% annual chance rainfall (1,000 year rainfall)

Upper Iowa
(77,000 acre-ft of runoff)

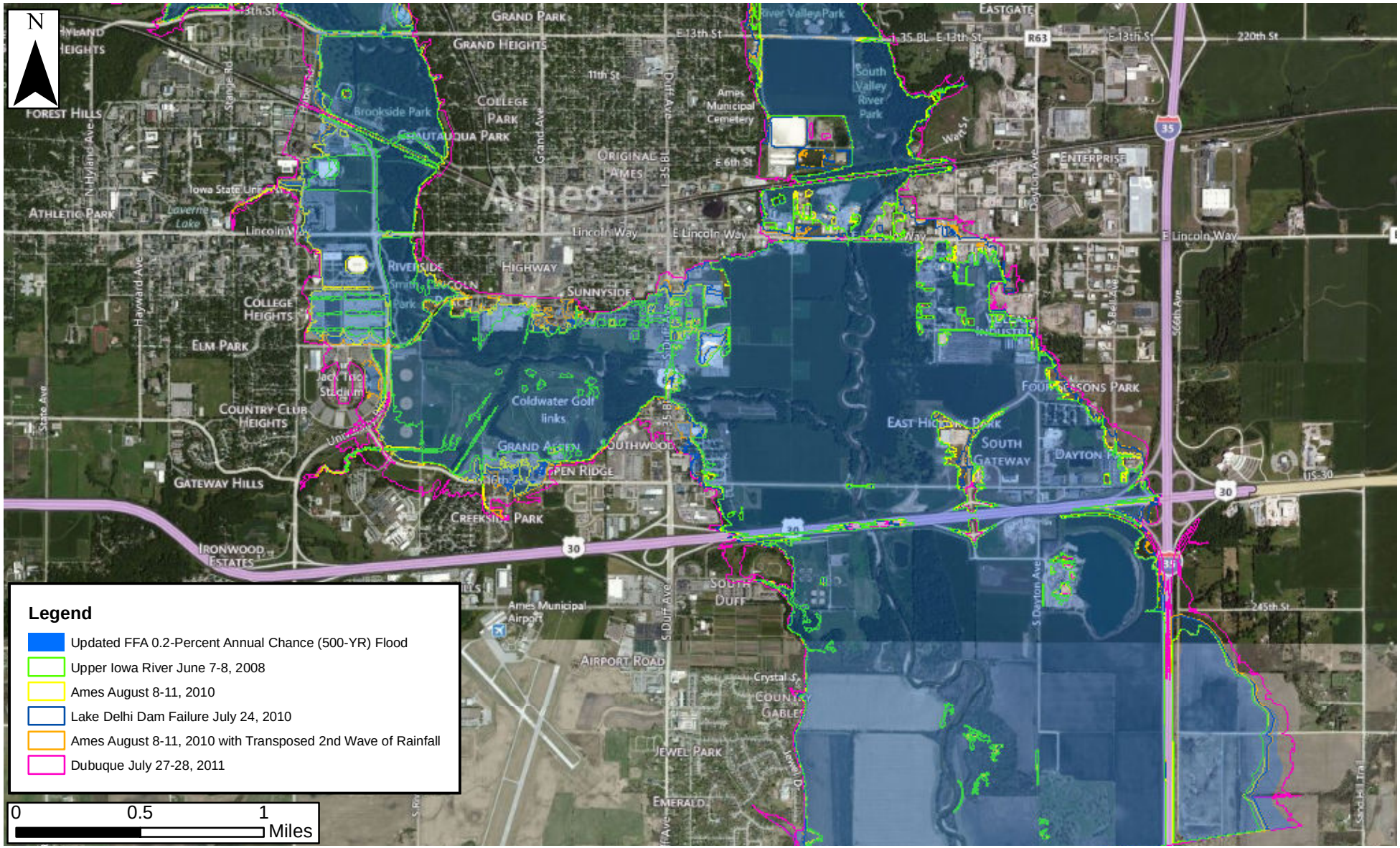
Ames
(69,000 acre-ft of runoff)

Lake Delhi Storm
(120,000 acre-ft of runoff)

Ames - Transposed
(187,000 acre-ft of runoff)

Dubuque
(103,000 acre-ft of runoff)

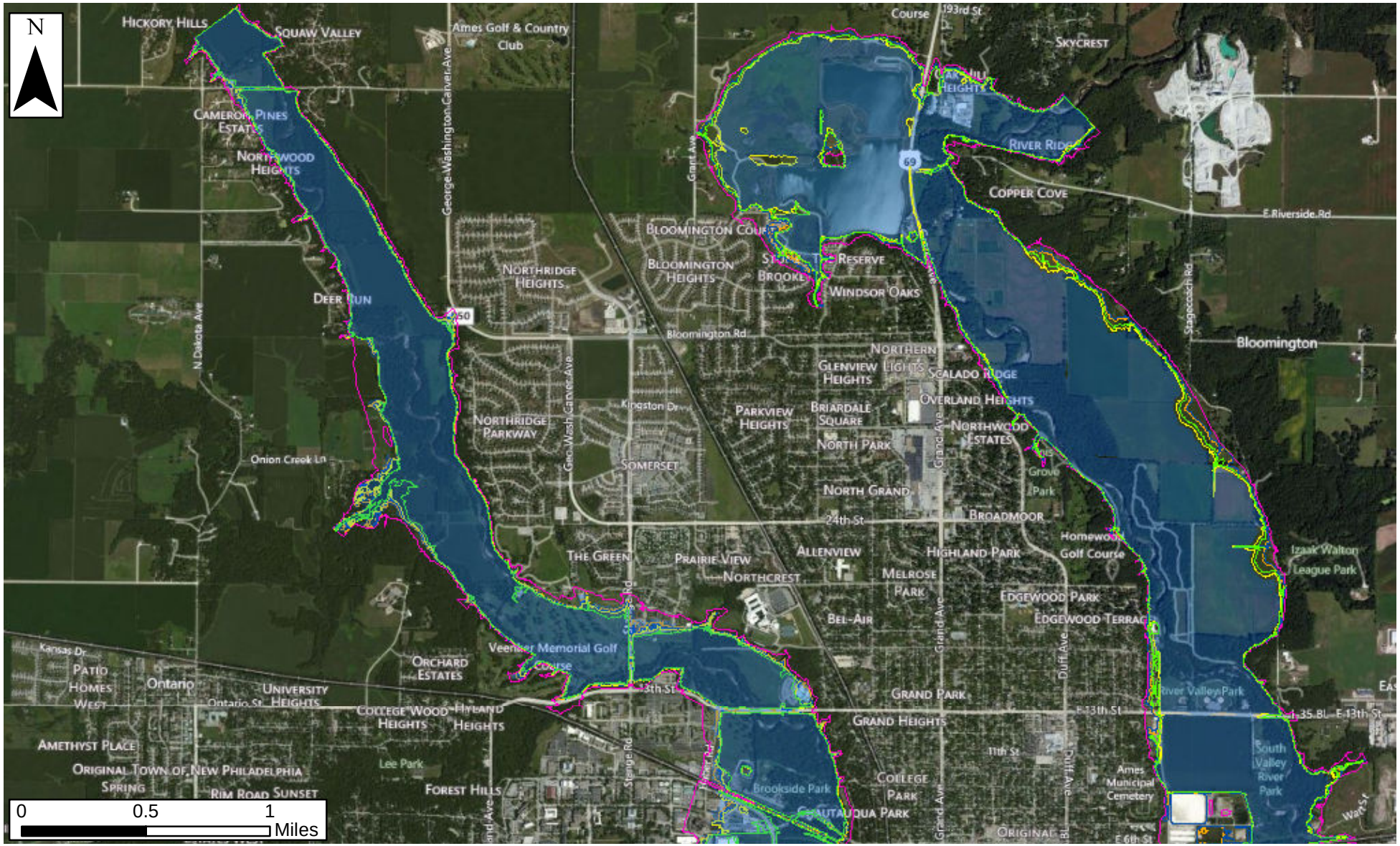
Flood Boundaries from Transposed Rainstorms



Confluence of Squaw Creek and Skunk River

* Approximate boundaries based on modeled inundation

Flood Boundaries from Transposed Rainstorms

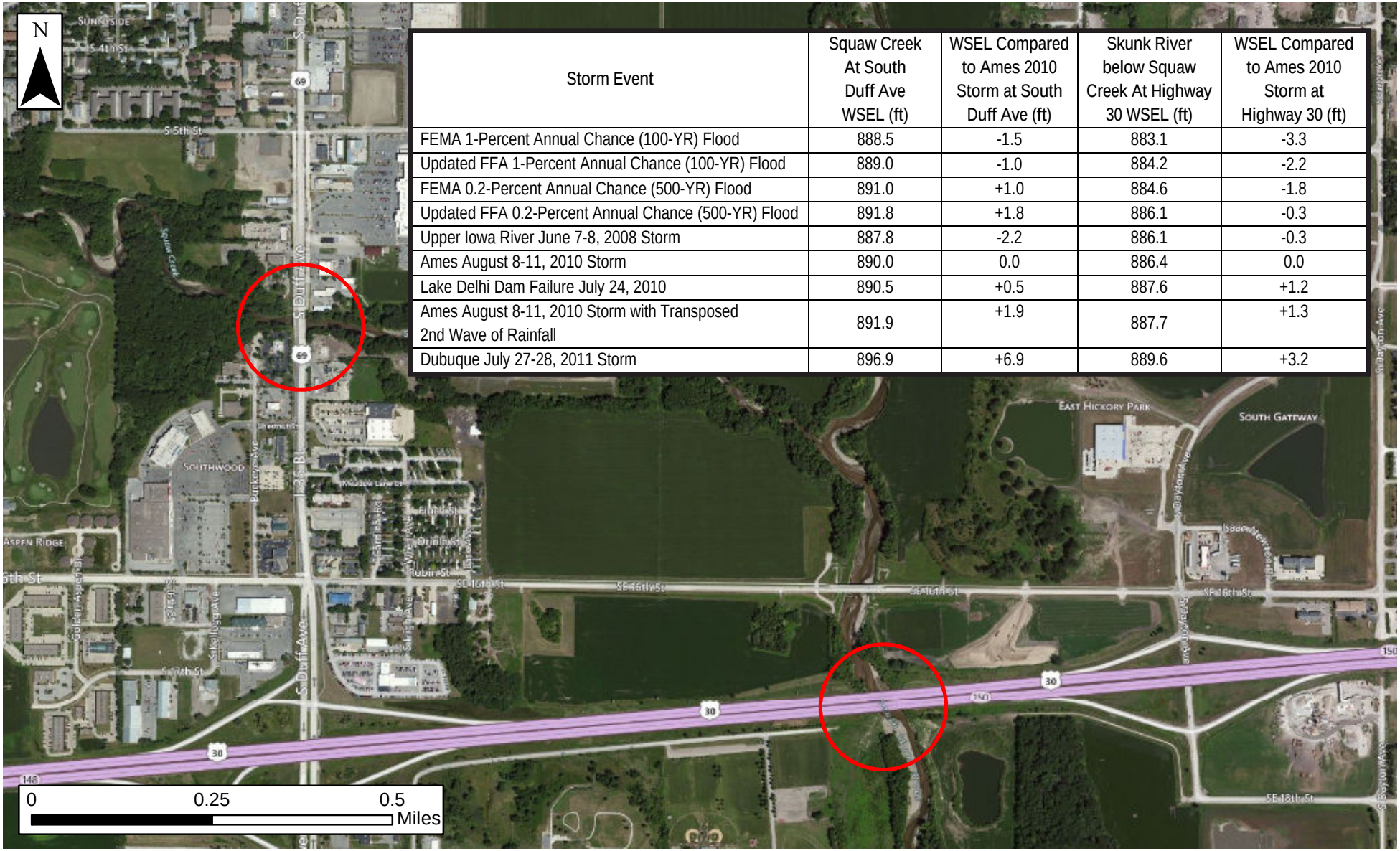


Squaw Creek and Skunk River

* Approximate boundaries based on modeled inundation

Water Surface Elevation Comparison

Storm Event	Squaw Creek At South Duff Ave WSEL (ft)	WSEL Compared to Ames 2010 Storm at South Duff Ave (ft)	Skunk River below Squaw Creek At Highway 30 WSEL (ft)	WSEL Compared to Ames 2010 Storm at Highway 30 (ft)
FEMA 1-Percent Annual Chance (100-YR) Flood	888.5	-1.5	883.1	-3.3
Updated FFA 1-Percent Annual Chance (100-YR) Flood	889.0	-1.0	884.2	-2.2
FEMA 0.2-Percent Annual Chance (500-YR) Flood	891.0	+1.0	884.6	-1.8
Updated FFA 0.2-Percent Annual Chance (500-YR) Flood	891.8	+1.8	886.1	-0.3
Upper Iowa River June 7-8, 2008 Storm	887.8	-2.2	886.1	-0.3
Ames August 8-11, 2010 Storm	890.0	0.0	886.4	0.0
Lake Delhi Dam Failure July 24, 2010	890.5	+0.5	887.6	+1.2
Ames August 8-11, 2010 Storm with Transposed 2nd Wave of Rainfall	891.9	+1.9	887.7	+1.3
Dubuque July 27-28, 2011 Storm	896.9	+6.9	889.6	+3.2



Evaluation Process

Flood Mitigation Alternatives & Strategies

The study team reviewed public input on alternatives and strategies. The initial list included:

Storage

- Centralized Flood Storage
- Regional Flood Storage
- Floodplain Storage
- Conservation Measures in Watershed

Protection

- Flood Water Diversion
- Conveyance Improvements
- Flood Proofing
- Levee along Skunk Creek
- Levee along Squaw Creek

Non-Structural

- Do Nothing
- Property Buyouts
- Floodplain Ordinance Modification

Evaluation Process

1 2 3 4 5

Flood Mitigation Alternatives & Strategies

Floodwall

Levee with Roadway

Floodwall

Levee with Roadway

Diversion

Dry Reservoir

Wetlands Restoration

Reservoir

Evaluation Process

Screening Criteria

The following criteria were used to narrow the initial alternatives to a list that will be more fully evaluated.

Level of Flood Protection

- Existing 1% Annual Chance Flood
- Updated 1% Annual Chance Flood
- 2010 Flood Event
- 2010 Flood Event with Transposed 2nd Day Rainfall

Feasibility

- Property Impacts
- Regulatory Constraints
- Technical Feasibility
- Ease of Implementation

Evaluation Process

What's Next?

These flood mitigation alternatives and strategies will be carried forward in the study; a combination of these options will be considered.

- Centralized flood storage
- Regional flood storage
- Floodplain storage
- Conservation measures in watershed
- Diversion
- Conveyance improvements
- Floodplain ordinance modification
- Levees along Skunk River
- Levees along Squaw Creek

Evaluation Process

Get Involved!

We want to hear from you:

- Complete a comment form today
- Visit us at **www.cityofames.org** and click the Flood Mitigation Study link
- Email us at **amesfloodstudy@cityofames.org**
- Send mail to:

  City of Ames

  Attn: John Dunn

  300 E. 5th Street

  Ames, IA 50010

Evaluation Process

Comment Guidelines

- Come up to the podium one person at a time.
- State and spell your name.
- You have 5 minutes to speak, as to ensure that everyone gets the opportunity to be heard.
- Please allow everyone to comment once before commenting a second time.
- Be kind and courteous to all.

Welcome!

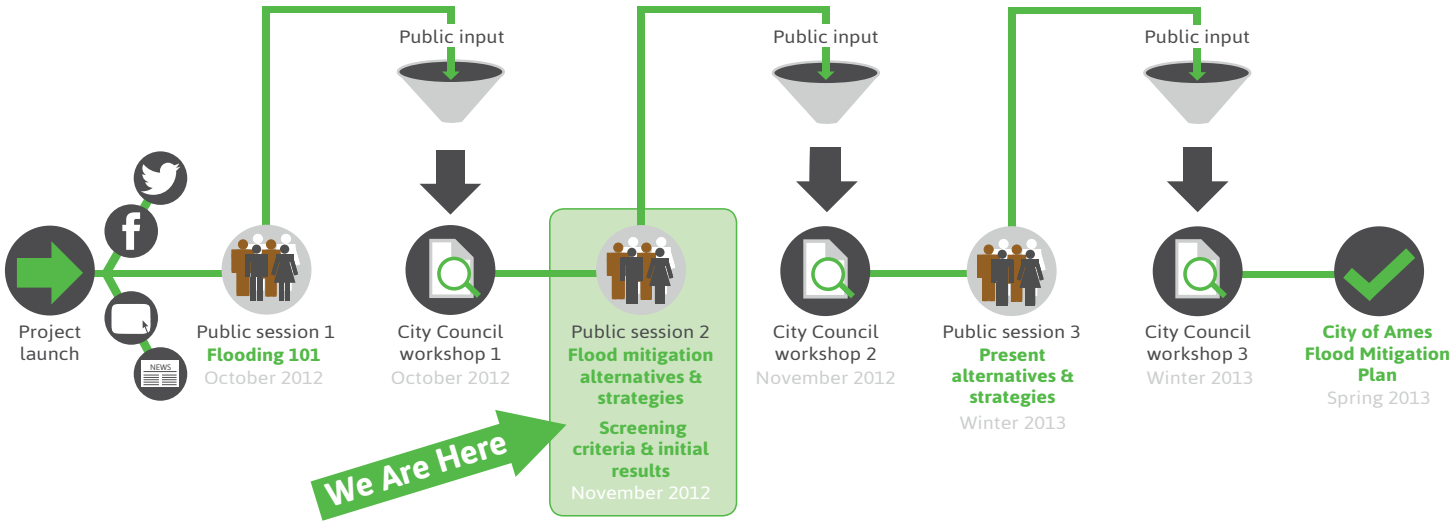
The purpose of this meeting is to discuss the City of Ames Flood Mitigation Study, present opportunities for community participation, and gather feedback regarding flooding issues and mitigation alternatives.

City of Ames Flood Mitigation Study

The Ames community's location at the confluence of Squaw Creek and South Skunk River has created challenges with flooding over the years. Major floods occurred in 1965, 1975, 1990, twice in 1993, 1996, 2007, 2008, and 2010. The most recent flood was severe and affected many residents and businesses. The flood of 2010 motivated the Ames City Council to pursue the Ames Flood Mitigation Study. The goal of this study is to develop a list of alternatives and strategies to reduce the impact of future flooding on the greater Ames community.

The Study Process

The information gathered from the public throughout the entire Study Process will be used to identify the best and most feasible alternatives and strategies that will be presented to City Council. As the timeline indicates below, this is your second opportunity to participate in this Study. Another meeting will be held in the Winter of 2013 to provide you with an opportunity to participate.



We want your input!

We want to hear from you:

- Complete a comment form today
- Visit us at www.cityofames.org and click the Flood Mitigation Study link
- Email us at: amesfloodstudy@cityofames.org
- Join us or attend Public Session 3 in Winter 2013
- Send mail to:
  City of Ames
  Attn: John Dunn
  300 E. 5th Street
  Ames, IA 50010

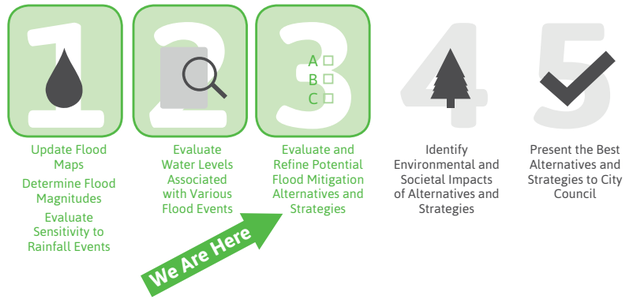
CITY OF Ames

Study Progress To Date

The City of Ames held Public Session 1 in early October 2012. Public Session 1 provided four different opportunities to learn about the Study, discuss flooding issues, and provide input on alternatives and strategies. Thank you for your input – we received great feedback and involvement from the greater Ames community. Since we last met in October, we:

- Mapped hydrologic changes in the greater Ames community
- Evaluated preliminary flood mitigation alternatives and strategies
- Determined initial flood mitigation screening criteria
- Analyzed initial flood mitigation strategies and alternatives

There are five steps to the Study:



Flood Mitigation Alternatives and Strategies

The initial list of flood mitigation alternatives and strategies includes:

- Do-nothing
- Centralized flood storage
- Regional flood storage
- Floodplain storage
- Conservation measures in watershed
- Diversion
- Conveyance improvements
- Flood proofing
- Levees along Skunk River
- Levees along Squaw Creek
- Property buyouts
- Floodplain ordinance modification

Preliminary Evaluation Criteria

The following evaluation criteria were used to determine the initial feasibility of each alternative and strategy:

Level of Flood Protection

- Existing 1% annual chance flood
- Updated 1% annual chance flood
- 2010 Flood event
- 2010 Event with transposed 2nd day rainfall

Feasibility

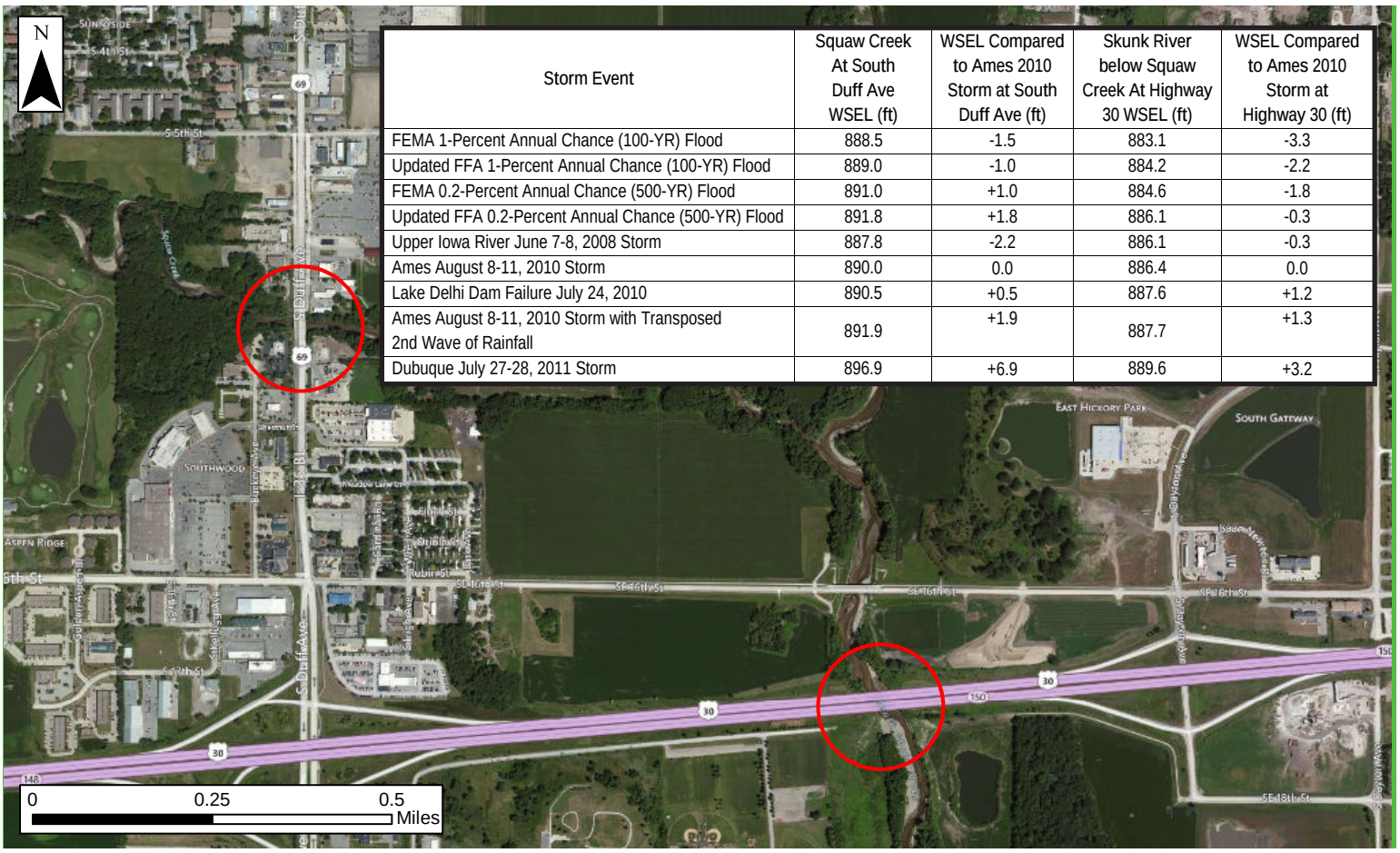
- Property impacts
- Regulatory constraints
- Technical feasibility
- Ease of implementation

Alternative/ Strategy	Description	Level of Flood Protection							
		Existing 1% Annual Chance Flood Event		Updated 1% Annual Chance Flood Event		2010 Event (0.2% Annual Chance) Flood Event		2010 Event with Transposed 2nd Day Rainfall	
		Squaw Creek	Skunk River	Squaw Creek	Skunk River	Squaw Creek	Skunk River	Squaw Creek	Skunk River
Centralized Flood Storage (Ames Reservoir + Squaw Creek Dry Detention)	The United States Army Corps of Engineers, USACE, (July 1987) re-evaluated Ames Lake, a multi-purpose flood control reservoir on the Skunk River with 89,500 acre-ft of flood control storage (5.2 inches of rainfall runoff). A reservoir with reduced flood capacity was also investigated (51,000 acre-ft (3.0-inches of rainfall)). The United States Army Corps of Engineers (July 1987) evaluated Squaw Creek Detention Reservoir (SC-1), a single purpose flood control detention dam with a dry reservoir. Its flood storage capacity was approximately 20,500 acre-ft (2.1 inches of rainfall runoff) at the top of the spillway, and 52,000 acre-ft (6.1 inches of rainfall runoff) at the top of the dam.	Y	Y	Y	Y	Y	Y	Y	Y
Regional Flood Storage (Tributary Detention + Smaller Main Stem Dams)	The USACE (July 1987) evaluated 14 sites (Including the Large Reservoir and Dry Detention Alternatives above) for use as multi-purpose projects.	Y	Y	Y	Y	P	P	N	N
Floodplain Storage	A series of small impoundments along the main channel of the Squaw Creek and Skunk River that store flood waters.	P	P	P	P	N	N	N	N
Conservation Measures in Watershed	The National Resource Conservation Service – Soil Conservation Service performed an analysis in 1985 looking at small detention sites in the watershed that could contribute to flood reduction. The Iowa Department of Agriculture and Land Stewardship administer the CREP program -Conservation Reserve Enhancement Program, which consists of constructed wetlands for flood control and water quality improvements.	N	N	N	N	N	N	N	N
Diversion	A diversion consists of diverting flood waters around Ames. This diversion consists of two alternatives. The first is diverting Squaw Creek at Cameron School Road to the Skunk River via Ada Hayden Reservoir. This is approximately a three mile diversion that also takes advantage of any additional storage provided by Ada Hayden Reservoir. The second alternative consists of diverting Squaw Creek upstream from Cameron School road to the Skunk River downstream from the Ames Municipal Airport. This is approximately a fourteen mile diversion.	Y	N	Y	N	Y	N	P	N
Conveyance Improvements	Conveyance improvements generally include channel improvements (clearing, excavating, shaping, lining) and bridge modifications. Two specific elements: 1. At least two bridges - Highway 30 Bridge over the Skunk River and South Duff Bridge over Squaw Creek – have been shown through hydraulic modeling and observed during flood events to restrict flows. The Iowa DOT has looked at increasing the length of the HWY 30 Bridge. The increased conveyance would lower flood levels in the lower reaches of Squaw Creek (South Duff area) during high flow events. 2. Conveyance Improvements include modification of road embankments in and around South Duff to lower flood levels in this area. This could include removing buildings and elevated roads in the South Duff commercial area to lower flood levels experienced in this area. This also includes blocking an overflow path that initiates when the Squaw Creek leaves its banks upstream from the South 4th Bridge.	N	N	N	N	N	N	N	N
Floodplain Ordinance Modification	Modification of existing City of Ames floodplain ordinance to restrict development in the floodplain this includes considering the 0.2 % (so called 500-year) floodplain boundary as the regulatory limit of the floodway fringe.	N	N	N	N	N	N	N	N
Levees along Skunk River	Several property areas along the Skunk River could be protected from floods by constructing a levee (berm/floodwall) combination. The two areas include both sides of the Skunk River between Lincoln Way and Union Pacific Railroad as well as a levee along the Freel Drive extension.	Y	Y	Y	Y	Y	Y	Y	Y
Levees along Squaw Creek	The property along South Duff could be protected by a levee (berm/floodwall) and necessary appurtenances. The likely alignment – partially studied by USACE – would tie into high ground near South 4th and Squaw Creek and run along the Creek before turning northward after protecting the commercial development built up near South Duff and tying into high ground along Lincoln Way. Protection to either the 500-year or the 2010 Event.	Y	Y	Y	Y	Y	Y	Y	Y

Key: **Y** = Yes, alternative provides respective level of flood protection; **N** = No, alternative does not provide respective level of flood protection; **P** = Alternative possibly provides respective level of flood protection; more detailed analysis required.

These flood mitigation alternatives and strategies will be carried forward in the study; a combination of these options will be considered (full table available online).

Water Surface Elevation Comparison



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South Skunk River below Squaw Creek near Ames, IA	Updated FFA	14,500	24,100	28,900	41,800
	FEMA Effective Flows	12,700	19,700	23,000	31,400

Storm	Total Rainfall Volume (Acre-Ft)	Total Run-off Volume (Acre-Ft)
100-year Existing Storm	197,000	55,100
Upper Iowa River June 7-8, 2008 Storm	215,000	77,000
Ames August 8-11, 2010 Storm	214,000	69,000
Lake Delhi Dam Failure July 24, 2010	266,000	103,000
Ames August 8-11, 2010 Storm with Transposed 2nd Wave of Rainfall	275,000	120,000
Dubuque July 27-28, 2011 Storm	233,000	187,000

FAQs

Q1: *What is the study area for the City of Ames Flood Mitigation Study*
A1: This study is aimed at addressing the concerns of the greater Ames community. Input, ideas, and concerns regarding flooding and potential solutions are being sought from any person, business, and property owner within the greater Ames community including Story County. Geographically the study is limited to the City of Ames and Story County.

Q2: *Why does the City of Ames allow development on South Duff?*
A2: The City of Ames Ordinance allows restricted development within the floodplain (including South Duff along Squaw Creek). The City does not allow development in the area that has been designated the "Floodway" unless there is a demonstrated public good that results from the development (bridge, culvert, etc). Any development in the floodway must not increase flood levels during the Base Flood (1% annual chance flood). The City allows development in the "Floodway Fringe" if the finished floor elevation is raised to the Base Flood elevation + 3 ft. This ensures that the development is a reasonable elevation above the Base Flood.

Q3: *We're in the middle of one of the worst droughts we've seen in decades. Why are we doing a flood study?*
A3: Most everyone who lives in Iowa recognizes that weather patterns come in cycles. You can think about "normal weather" as being the average of the two extremes. There is no doubt that the rain will return; and drawing on Ames' history, at some point we will have another flood. Remember that one of the most severe droughts experienced in Ames in recent history (1976-77) was broken by a major flood.

Q4: *How will the city pay for additional changes/improvements to infrastructure (if any)?*
A4: The actual funding strategy will certainly be dependent upon the type of improvements or modifications being proposed, and could vary from one mitigation measure to the next. It is possible that funding could be provided through any combination of the following: FEMA Hazard Mitigation Grants or other grant opportunities; low interest loans from the Clean Water State Revolving Fund; storm water utility fees; or any of several local taxes (general levy, general obligation or revenue abated bonds, or local option sales tax). Suggestions on likely sources of non-property tax supported funding would be very much appreciated.

Q5: *How will your mitigation efforts affect those small towns down stream?*
A5: Any impact of a mitigation alternative on a downstream community will be analyzed and reported as part of this study.

Key Terms

1% Annual Chance Flood: A flood having a one percent chance of being equaled or exceeded in any given year for a given area. Also known as a Base Flood, and commonly referred to as 100-Year Flood.

Diversion: A riverine structure and channel designed to allow floodwaters to bypass flood susceptible areas.

Floodplain: Any land area susceptible to being inundated by riverine flooding.

Floodway: The channel of a river or stream and those portions of the floodplain adjoining the channel that are reasonably required to carry and discharge flood waters or flood flows so that confinement of flood flows to the floodway area will not cumulatively increase the water surface elevation of the base flood by more than one foot.

Floodway Fringe: That area of the floodplain, outside the floodway, that has a 1% chance of flood occurrence in any one year.

Levee: A structure, such as an earthen embankment or concrete wall designed to reduce flood damages by protecting property from flooding.

Localized Flooding versus Riverine Flooding: Riverine flooding is related to floodwaters originating in Rivers, such as the Skunk River or Squaw Creek. Localized flooding relates to the backup of storm sewers, flooding of yards and basements, and street flooding not related directly to rivers.

City of Ames Flood Mitigation Study – Preliminary Screening

Alternative/Strategy	Alternative/Strategy Description	Level of Flood Protection								Feasibility Property Impacts/Regulatory/Technical/ Ease of Implementation	Preliminary Screening Results
		Existing 1% Annual Chance Flood Event		Updated 1% Annual Chance Flood Event		2010 Event		2010 Event with Transposed 2nd Day Rainfall			
		Squaw Creek	Skunk River	Squaw Creek	Skunk River	Squaw Creek	Skunk River	Squaw Creek	Skunk River		
1. Do-Nothing	No permanent infrastructure improvements or floodplain development restrictions enacted; temporary measures for access and property protection would be employed by the City of Ames and private property owners.	N	N	N	N	N	N	N	N	It is not possible to protect property in flood prone areas from flood damage due to the short amount of warning time available. This would be easy to implement.	A do nothing approach is unacceptable from a social, political, and economic point of view. Alternative will be carried forward for comparative purposes with other alternatives.
2. Centralized Flood Storage (Ames Reservoir+ Squaw Creek Dry Detention)	The United States Army Corps of Engineers (July 1987) re-evaluated Ames Lake, a multi-purpose flood control reservoir on the Skunk River with 89,500 acre-ft of flood control storage (5.2 inches of rainfall runoff). A reservoir with reduced flood capacity was also investigated (51,000 acre-ft (3.0-inches of rainfall)). The United States Army Corps of Engineers (July 1987) evaluated Squaw Creek Detention Reservoir (SC-1), a single purpose flood control detention dam with a dry reservoir. Its flood storage capacity was approximately 20,500 acre-ft (2.1 inches of rainfall runoff) at the top of the spillway, and 52,000 acre-ft (6.1 inches of rainfall runoff) at the top of the dam.	Y	Y	Y	Y	Y	Y	Y	Y	At the time of the evaluation, both a larger, authorized multi-purpose reservoir, and a smaller multi-purpose reservoir were found not to be feasible for economic (larger) and political (smaller) reasons. For reference the volume associated with a 1% annual chance rainfall is: 55,100 acre-ft. The volume associated with the 2010 Storm Event is: 69,000 acre-ft. The runoff volume associated with the 2010 Storm Event (Transposed Rainfall) is: 120,000 acre-ft. The large reservoir impacted 5,000 acres in its flood pool including residences and farmsteads and the smaller reservoir impacted 3,620 acres. The dry detention site at flood pool requires 1,430 acres of flood pool.	Alternative is carried forward. Locating structures on the main channel allows design to likely limit flood damage for all four design events. Environmental, social, and property impacts are substantial and will be identified, in conjunction with costs and potential flood reduction benefits.
3. Regional Flood Storage (Tributary Detention + Smaller Main Stem Dams	The United States Army Corps of Engineers (July 1987) evaluated 14 sites (Including the Large Reservoir and Dry Detention Alternatives above) for use as multi-purpose projects.	Y	Y	Y	Y	P	P	N	N	USACE was specifically looking for sites that met the surface area and watershed area requirements leading to multi-purpose project, and only four sites had potential as a multi-purpose project. Several sites may have possibilities as a single purpose (flood control) site. This could impact up to 14,000 acres of private land.	Alternative is carried forward. The detention projects could be designed to meet flood damage reduction objectives. The combination of main stem and tributary detention controls runoff from over half of the watershed. This is a significant enough magnitude to likely meet the 1% annual chance flood and potentially the 2010 event flood damage reduction objectives.

Alternative/Strategy	Alternative/Strategy Description	Level of Flood Protection								Feasibility Property Impacts/Regulatory/Technical/ Ease of Implementation	Preliminary Screening Results
		Existing 1% Annual Chance Flood Event		Updated 1% Annual Chance Flood Event		2010 Event		2010 Event with Transposed 2nd Day Rainfall			
		Squaw Creek	Skunk River	Squaw Creek	Skunk River	Squaw Creek	Skunk River	Squaw Creek	Skunk River		
4. Floodplain Storage	A series of small impoundments along the main channel of the Squaw Creek and Skunk River that store flood waters.	P	P	P	P	N	N	N	N	This is alternative is technically feasible and property impacts are limited to land near floodplains, but significant amount of property would be required to gain the storage. Preliminary investigation shows that creating impoundments by modifying county road crossings and/or building weirs can provide on average 500 acre-ft of additional flood storage per county road crossing/and or weir. Based on initial calculations, floodplain storage would require 55 crossing modifications as well as property purchases and/or easement along the entire length of Squaw Creek and the Skunk River to control half the storm volume from the 100-year event. It would require 70 crossing modifications to meet the 2010 protection requirements. This alternative has a significant amount of environmental as well as private property impact. From an implementation perspective, many of these modifications may have limited negative impact, and therefore may be able to be enacted as funds become available.	Alternative is carried forward, though not as a stand-alone solution. This alternative provides additional storage in the floodplain and will provide some benefit by reducing the amount of flood flow in the river. It is recommended that the alternative be analyzed in additional detail to facilitate combination with other alternatives.
5. Conservation Measures in watershed	The National Resource Conservation Service – Soil Conservation Service performed an analysis in 1985 looking at small detention sites in the watershed that could contribute to flood reduction. The Iowa Department of Agriculture and Land Stewardship administer the CREP program - Conservation Reserve Enhancement Program, which consists of constructed wetlands for flood control and water quality improvements.	N	N	N	N	N	N	N	N	The SCS found that only 2 % of the watershed could be controlled by small flood control and conservation projects with a drainage area of less than 5 square miles (typically 30 to 50 percent is required to have an impact). Within the Skunk River and Squaw Creek watershed there are 4 developed sites and approximately 50 more that have been identified by IDALS. A typical size of a restored wetland project would contain 4.5 acre ft of flood storage, assuming they each control 1000 acres, have 100 acres of space, and are on average less than 3-ft deep.	Alternative is carried forward, though not as a stand-alone solution. This alternative provides additional storage as well as water quality benefits and will provide some benefit by reducing the amount of flood flow in the river. It is recommended that the alternative be analyzed in additional detail to facilitate combination with other alternatives.

Alternative/Strategy	Alternative/Strategy Description	Level of Flood Protection								Feasibility Property Impacts/Regulatory/Technical/ Ease of Implementation	Preliminary Screening Results
		Existing 1% Annual Chance Flood Event		Updated 1% Annual Chance Flood Event		2010 Event		2010 Event with Transposed 2nd Day Rainfall			
		Squaw Creek	Skunk River	Squaw Creek	Skunk River	Squaw Creek	Skunk River	Squaw Creek	Skunk River		
										The number of restored wetlands in the watershed to make a significant difference would be approximately 6,100. The number and extent of potential CREP sites are limited by topography and drainage patterns, resulting in insufficient storage volume to make this a viable stand-alone alternative. The impacts to private property are significant. From an implementation perspective, many of the wetland restoration sites may have limited negative impact, and therefore may be able to be constructed as funds/property become available.	
6. Diversion	A diversion consists of diverting flood waters around Ames. This diversion consists of two alternatives. The first is diverting Squaw Creek at Cameron School Road to the Skunk River via Ada Hayden Reservoir. This is approximately a three mile diversion that also takes advantage of any additional storage provided by Ada Hayden Reservoir. The second alternative consists of diverting Squaw Creek upstream from Cameron School road to the Skunk River downstream from the Ames Municipal Airport. This is approximately a fourteen mile diversion.	Y	N	Y	N	Y	N	P	N	This alternative requires acquisition of significant Right-of-Way, impacts the landscape, and requires commitment of significant construction dollars.	This alternative is carried forward. It can be designed to meet flood reduction objectives, especially along Squaw Creek.
7. Conveyance Improvements	Conveyance improvements generally include channel improvements (clearing, excavating, shaping, lining) and bridge modifications. Two specific elements: 1. At least two bridges - Highway 30 Bridge over the Skunk River and South	N	N	N	N	N	N	N	N	Conveyance improvements are technically feasible; however significant issues to be addressed include environmental impacts, land acquisition, and transportation system impacts. Many of the improvements could be easily implementable, such as, channel shaping near a	Alternative is carried forward, though not as a stand alone option. The enactment of any one conveyance improvement does not meet the project objectives. However, conveyance improvements will likely be combined with other alternatives to lower water

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		Squaw Creek	Skunk River	Squaw Creek	Skunk River	Squaw Creek	Skunk River	Squaw Creek	Skunk River		
	Duff Bridge over Squaw Creek – have been shown through hydraulic modeling and observed during flood events to restrict flows. The Iowa DOT has looked at increasing the length of the HWY 30 Bridge. The increased conveyance would lower flood levels in the lower reaches of Squaw Creek (South Duff area) during high flow events. 2. Conveyance Improvements include modification of road embankments in and around South Duff to lower flood levels in this area. This could include removing buildings and elevated roads in the South Duff commercial area to lower flood levels experienced in this area. This also includes blocking an overflow path that initiates when the Squaw Creek leaves its banks upstream from the South 4th Bridge.									bridge. As part of this alternative any impact downstream of the City of Ames due to conveyance improvements would be quantified	surface elevations and reduce flood damages.
8. Flood Proofing	Structural improvements to buildings to dry-proof; site grading/improvements to facilitate flood fighting closures. Structures would be raised to above 500-yr or to the 2010 level.	Y	Y	Y	Y	N	N	N	N	Flood-proofing all impacted structures to the 2010 or 500-yr event is likely technically feasible. Even though flood-proofing measures may prevent property damage, evacuation will be required due to utility and access impacts. As part of response to the 1993 flood, flood proofing private property with funds from FEMA was made available to City of Ames residents, but was not widely implemented.	Alternative is not carried forward. Alternative does not meet flood damage reduction goals. Flood proofing is possible for up to 3-ft. City history with this alternative is not positive.
9. Levees along Skunk River	Several property areas along the Skunk River could be protected from floods by constructing a levee (berm/floodwall) combination. The two areas include both sides of the Skunk River between Lincoln Way and Union Pacific Railroad as well as a levee along the Freel Drive extension.	Y	Y	Y	Y	Y	Y	Y	Y	Levees are technically feasible. Interior drainage, underseepage, and space constraints for levee footprint are issues that must be addressed for alternative to meet objectives.	Alternative is carried forward. The alternative can be designed to meet objectives.

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10. Levees along Squaw Creek	The property along South Duff could be protected by a levee (berm/floodwall) and necessary appurtenances. The likely alignment – partially studied by USACE – would tie into high ground near South 4th and Squaw Creek and run along the Creek before turning northward after protecting the commercial development built up near South Duff and tying into high ground along Lincoln Way. Protection to either the 500-year or the 2010 Event.	Y	Y	Y	Y	Y	Y	Y	Y	Levees are technically feasible. Interior drainage, underseepage, and space constraints for levee footprint are issues that must be addressed for alternative to meet objectives.	Alternative is carried forward. The alternative can be designed to meet objectives.
11. Property Buyouts	Purchase of structures and property potentially impacted by 500-yr event or 2010 Event.	N	N	N	N	N	N	N	N	Buyout of impacted properties is technically feasible, although the magnitude of the economic impact to the City of Ames of removing the commercial and residential property is substantial and extends beyond the short term expense of acquisition.	Alternative is not carried forward. In select situations it could be combined with another alternative.
12. Floodplain Ordinance Modification	1. 100-year floodplain becomes the floodway. This strategy would limit development within the regulatory 1% annual chance footprint. 2. 2010 inundation limit becomes the floodway. This strategy would limit development within the 2010 inundation footprint. 3. Regulate to the base flood + 5-ft. This strategy would allow development within the current regulatory floodplain but require the finished flood elevations to be 5-ft higher than the base flood (1% annual chance) 4. Modify floodplain extent to be extent of the floodplain associated with base flood plus 3 ft. This strategy modifies the area where development is allowed but restricted to be the base flood plus 3-ft. 5. Regulate to the 500-year Event. This strategy modifies the area where development is allowed but restricted	N	N	N	N	N	N	N	N	These are easily implementable and technically feasible but impact to economic development needs to be analyzed. Also, adopting new development standards in the floodplain may lesson the storage requirement from the storage alternatives (Centralized Flood Storage, Regional Flood Storage, Floodplain Storage). They have limited impacts to environmental resources.	This alternative is being carried forward though not as a stand-alone solution. None of these strategies provide protection for existing infrastructure. The differences in these strategies will be quantified and the best will be combined other strategies or alternatives enacted in the future.

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	to be the 500-year floodplain. 6. Redefine the floodway based on new modeling. This strategy requires a new floodway to be developed and adopted. 7. Enact compensatory storage requirements. This strategy requires adoption of new municipal code that would require any fill that is put into the floodway fringe to be compensated by removing floodway fringe elsewhere in the fringe. 8. Develop and maintain 2D model that can quantify impact of individual structures on floodplain. This strategy requires a development of a model – or adoption from Iowa DOT model to use for regulation of the floodplains. 9. Adopt a lifetime cumulative damage limit for properties in the floodplain.										

Key: Y = Yes, alternative provides respective level of flood protection
N= No, alternative does not provide respective level of flood protection
P = Alternative possibly provides respective level of flood protection; more detailed analysis required.