

## Chapter 7: HARA, Step 4: Estimate Losses

The final step in the risk assessment is to determine the likely level of losses for each type of disaster event determined likely to occur in the jurisdiction or its area of influence. Because FEMA is most concerned about natural hazards and because it is difficult to measure losses from non-natural hazard events due to poor data, the Marion County Hazard Mitigation Planning Team has only considered losses due to natural hazards. The loss estimation phase includes: 1) the descriptions of loss estimation techniques, 2) the losses for each hazard event, 3) the losses for each year by hazard by jurisdiction, and 4) data limitations/corrective actions. This chapter also considers future losses due to new development in the county.

### 7.1: Loss Estimation Techniques

To complete this process, we take the data from the asset assessment in *Chapter 6*. We use several loss formulas based on the likely damages that each asset may receive from each type of event. The following formulas can be used:

Structures: structure replacement value X percent damaged = loss to structure

Contents: contents replacement value X percent damaged = loss to contents

Functional/use: functional downtime cost (average daily operating budget X days) + displacement cost (displacement costs per day X days displaced) = functional loss

Total estimated losses to asset: structure loss + contents and inventory loss + functional loss = total

FEMA and HAZUS provide data tables to estimate the numbers used in the above formulas for certain hazards.

The following describes the level or intensity of a hazard event used in this analysis:

- ☛ Dam failure: complete failure of the largest dam in the jurisdiction.
- ☛ Drought: equal to the worst drought experienced in the area, as recorded by the NCDC.
- ☛ Earthquake: an intensity of MM IV, which is recognized as most intense likely event in this area.
- ☛ Expansive soils: events as have occurred in the area in the past 10 years.
- ☛ Extreme heat: as described in the definition of this hazard.
- ☛ Flash flood: flooding due to saturated ground followed by 5” or more of rain in 24 hours.
- ☛ Grass or wildland fire: fire of 10 acres or more of vegetation.
- ☛ Hailstorm: event with hail of 1” or larger.
- ☛ Landslide: event on developed (not heavily forested lands and river banks) involving at least 1 ton of soil.
- ☛ River flood: 100-year flood event (not necessarily occurring every 100 years)
- ☛ Severe winter storm: Snow, ice, and severe wind chills as defined in profile.
- ☛ Sinkhole: As defined in the hazard profile.
- ☛ Thunderstorm and lightning: As defined in the hazard profile.
- ☛ Tornado: Average storm of EF2 touchdown in terms of damages and area impacted
- ☛ Windstorm: 60 knots+ straight-line winds and average damages per storm.

The Marion County Hazard Mitigation Planning Team *should* use GIS and other local data along with HAZUS formulas in “Understanding Your Risks” to determine losses by asset and then add impacts by each hazard. By doing this, a matrix is developed to determine total likely losses by asset by hazard. Because there is no data in the county about the losses by structure at this time, this chapter considers overall losses by event and then the probability of each applicable hazard event in a given year.

### 7.2: Estimate of Losses by Natural Hazard Event

The following tables describe the potential losses by natural hazard event as they can occur in modern times. This data is estimated and should not be used for official agency action.

**Table 7.1: Estimated Losses by Hazard Event in Rural Marion County (including all townships, federal land, and Twin Cedars Schools)**

Event	Res.	Com.	Ind.	Ag. Str.	Ag. Land	Instit.	Gov. *	Ed. **	Util.	Totals	Dths.
Dam failure	\$500 K	\$25,000	\$0	\$100 K	\$100K	\$10,000	\$500 K	\$0	\$500 K	\$1.74 M	0-3
Drought	\$600 K	\$38,600	\$4,800	\$38,100	\$2.37 M	\$20,000	\$300 K	\$32,000	\$100 K	\$3.5 M	0
Earthquake	\$60,000	\$1,900	\$300	\$1,300	\$2,400	\$2,000	\$100 K	\$3,200	\$50,000	\$227 K	0
Expansive soils	\$240 K	\$12,000	\$1,200	\$10,200	\$24,000	\$6,000	\$90,000	\$1,600	\$90,000	\$475 K	0
Extreme heat	\$300 K	\$19,000	\$4,800	\$12,700	\$473 K	\$10,000	\$100 K	\$16,000	\$400 K	\$1.34 M	0-2
Flash flood	\$1.2 M	\$39,600	\$3,200	\$38,100	\$709 K	\$30,000	\$500 K	\$16,000	\$400 K	\$3.02 M	<=1
Grass/wildland fire	\$120 K	\$3,900	\$300	\$10,160	\$237 K	\$2,000	\$50,000	\$4,800	\$30,000	\$458 K	<=1
Hailstorm	\$480 K	\$15,500	\$1,600	\$12,700	\$1.18 M	\$10,000	\$200 K	\$6,400	\$40,000	\$1.95 M	<=1
Landslide	\$5,000	\$1,000	\$1,000	\$100	\$10,000	\$1,000	\$5,000	\$0	\$10,000	\$33,100	0
Levee failure	\$100 K	\$25,000	\$25,000	\$20,000	\$20,000	\$0	\$500 K	\$0	\$250 K	\$940 K	0-2
River flood	\$250 K	\$0	\$0	\$50,000	\$250 K	\$0	\$2 M	\$0	\$500 K	\$2.78 M	<=1
Severe winter storm	\$360 K	\$57,900	\$4,800	\$12,700	\$71,000	\$10,000	\$200 K	\$16,000	\$300 K	\$992 K	0-3
Sink hole	\$60,000	\$3,900	\$300	\$1,250	\$24,000	\$1,000	\$30,000	\$1,600	\$20,000	\$142 K	<=1
Thunderstorm/ Lightning	\$120 K	\$3,900	\$240	\$2,500	\$24,000	\$2,000	\$50,000	\$800	\$70,000	\$273 K	<=1
Tornado	\$600 K	\$19,300	\$1,600	\$12,700	\$118 K	\$10,000	\$200 K	\$8,000	\$200 K	\$1.32 M	0-7
Windstorm	\$600 K	\$19,300	\$1,600	\$12,700	\$237 K	\$5,000	\$150 K	\$6,400	\$700 K	\$1.73 M	<=1
<b>Totals</b>	<b>\$5.6 M</b>	<b>\$286 K</b>	<b>\$25,765</b>	<b>\$335 K</b>	<b>\$6.03 M</b>	<b>\$119 K</b>	<b>\$4.98 M</b>	<b>\$113 K</b>	<b>\$3.66 M</b>	<b>\$20.92 M</b>	<b>0-18</b>

Losses are based on data from NCDC, local officials, FEMA, and the State of Iowa Hazard Mitigation Plan.

-- Hazard cannot occur in jurisdiction or does very little or no notable damage.

\* Includes public streets and bridges and public water/sewer lines as much as possible.

\*\* Twin Cedars Schools assets

The natural hazards considered are estimated to have an impact of \$21 million total per event as well as up to but no more than 18 fatalities in rural parts of Marion County.

**Table 7.2: Estimated Losses by Hazard Event in Bussey**

Event	Res.	Com.	Ind.	Ag. Str.	Ag. Land	Instit.	Gov. *	Ed.	Util.	Totals	Dths.
Dam failure	--	--	--	--	--	--	--	--	--	--	--
Drought	\$7,300	\$1,000	\$0	\$30	\$5,000	\$6,000	\$9,000	\$0	\$600	\$28,930	0
Earthquake	\$750	\$50	\$0	\$10	\$10	\$600	\$3,000	\$0	\$300	\$4,720	0
Expansive soils	\$14,600	\$750	\$0	\$50	\$100	\$4,500	\$6,000	\$0	\$600	\$26,600	0
Extreme heat	\$7,300	\$1,000	\$0	\$20	\$1,000	\$3,000	\$3,000	\$0	\$4,800	\$20,120	<=1
Flash flood	\$58,400	\$4,000	\$0	\$50	\$600	\$18,000	\$24,000	\$0	\$4,800	\$109,850	<=1
Grass/wildland fire	\$15,000	\$1,000	\$0	\$200	\$5,000	\$6,000	\$9,000	\$0	\$3,000	\$39,200	<=1
Hailstorm	\$36,500	\$2,500	\$0	\$100	\$5,000	\$9,000	\$15,000	\$0	\$300	\$68,400	<=1
Landslide	--	--	--	--	--	--	--	--	--	--	--
Levee failure	--	--	--	--	--	--	--	--	--	--	--
River flood	\$0	\$0	\$0	\$0	\$250	\$0	\$0	\$0	\$0	\$250	0
Severe winter storm	\$58,400	\$15,000	\$0	\$100	\$300	\$18,000	\$30,000	\$0	\$12,000	\$133.8 K	<=1
Sink hole	\$6,000	\$1,000	\$0	\$100	\$100	\$1,000	\$1,200	\$0	\$150	\$9,550	<=1
Thunderstorm/ Lightning	\$14,600	\$1,000	\$0	\$100	\$100	\$6,000	\$15,000	\$0	\$4,200	\$41,000	<=1
Tornado	\$146 K	\$10,000	\$0	\$2,000	\$2,000	\$60,000	\$60,000	\$0	\$12,000	\$146 K	0-7
Windstorm	\$21,900	\$1,500	\$0	\$100	\$700	\$900	\$9,000	\$0	\$4,800	\$38,900	<=1
<b>Totals</b>	<b>\$386.8 K</b>	<b>\$38,800</b>	<b>\$0</b>	<b>\$2,860</b>	<b>\$20,160</b>	<b>\$133 K</b>	<b>\$184.2 K</b>	<b>\$0</b>	<b>\$47,550</b>	<b>\$667.3 K</b>	<b>0-12</b>

Losses are based on data from NCDC, local officials, FEMA, and the State of Iowa Hazard Mitigation Plan.

-- Hazard cannot occur in jurisdiction or does very little or no notable damage.

\* Includes public streets and bridges and public water/sewer lines as much as possible.

The natural hazards considered are estimated to have an impact of \$667,320 total per event as well as up to but no more than 12 fatalities in Bussey.

**Table 7.3: Estimated Losses by Hazard Event in Harvey**

Event	Res.	Com.	Ind.	Ag. Str.	Ag. Land	Instit.	Gov. *	Ed.	Util.	Totals	Dths.
Dam failure	\$200 K	\$50,000	\$0	\$0	\$10,000	\$50,000	\$100 K	\$0	\$50,000	\$460,000	0-2
Drought	\$4,100	\$600	\$0	\$0	\$3,000	\$1,000	\$3,000	\$0	\$500	\$12,200	0
Earthquake	\$400	\$100	\$0	\$0	\$10	\$100	\$1,000	\$0	\$250	\$1,860	0
Expansive soils	\$8,200	\$450	\$0	\$0	\$150	\$750	\$2,000	\$0	\$500	\$12,050	0
Extreme heat	\$4,100	\$600	\$0	\$0	\$600	\$500	\$1,000	\$0	\$4,000	\$10,800	<=1
Flash flood	\$32,800	\$2,400	\$0	\$0	\$1,800	\$3,000	\$8,000	\$0	\$4,000	\$52,000	<=1
Grass/wildland fire	\$12,300	\$600	\$0	\$0	\$15,000	\$1,000	\$3,000	\$0	\$2,500	\$34,400	<=1
Hailstorm	\$20,500	\$1,500	\$0	\$0	\$15,000	\$1,500	\$5,000	\$0	\$250	\$43,750	<=1
Landslide	--	--	--	--	--	--	--	--	--	--	--
Levee failure	\$100 K	\$0	\$0	\$0	\$5,000	\$25,000	\$50,000	\$0	\$25,000	\$205,000	<=1
River flood	\$50,000	\$15,000	\$0	\$0	\$10,000	\$1,000	\$25,000	\$0	\$25,000	\$126,000	<=1
Severe winter storm	\$32,800	\$9,000	\$0	\$0	\$900	\$3,000	\$10,000	\$0	\$10,000	\$65,700	<=1
Sink hole	\$3,300	\$1,000	\$0	\$0	\$200	\$500	\$1,000	\$0	\$1,000	\$7,000	<=1
Thunderstorm/ Lightning	\$8,200	\$600	\$0	\$0	\$300	\$1,000	\$5,000	\$0	\$3,500	\$18,600	<=1
Tornado	\$82,000	\$6,000	\$0	\$0	\$6,000	\$10,000	\$20,000	\$0	\$10,000	\$134,000	0-6
Windstorm	\$12,300	\$900	\$0	\$0	\$2,100	\$1,500	\$3,000	\$0	\$4,000	\$23,800	<=1
<b>Totals</b>	\$571,000	\$88,750	\$0	\$0	\$70,060	\$99,850	\$237,000	\$0	\$140,500	\$1,207 K	0-12

Losses are based on data from NCDC, local officials, FEMA, and the State of Iowa Hazard Mitigation Plan.

-- Hazard cannot occur in jurisdiction or does very little or no notable damage.

\* Includes public streets and bridges and public water/sewer lines as much as possible.

The natural hazards considered are estimated to have an impact of \$1,207,160 total per event as well as up to but no more than 12 fatalities in Harvey.

**Table 7.4: Estimated Losses by Hazard Event in Knoxville (including Knoxville Schools and Hospital)**

Event	Res.	Com.	Ind.	Ag. Str.	Ag. Land	Instit.	Gov. *	Ed.	Util.	Totals	Dths.
Dam failure	--	--	--	--	--	--	--	--	--	--	--
Drought	\$230 K	\$112 K	\$28,500	\$300	\$10,000	\$100 K	\$200 K	\$50 K	\$50,000	\$780,800	0
Earthquake	\$23,000	\$5,600	\$1,900	\$10	\$10	\$20,000	\$100 K	\$6,000	\$25,000	\$181,520	0
Expansive soils	\$250 K	\$84,000	\$14,250	\$80	\$250	\$100 K	\$150 K	\$30 K	\$50,000	\$678,580	0
Extreme heat	\$230 K	\$112 K	\$28,500	\$200	\$1,000	\$100 K	\$100 K	\$30 K	\$300 K	\$901,700	0-2
Flash flood	\$1 M	\$336 K	\$57,000	\$300	\$2,500	\$500 K	\$750 K	\$240 K	\$350 K	\$3.24 M	0-2
Grass/wildland fire	\$230 K	\$56,000	\$9,500	\$2,000	\$25,000	\$50,000	\$50,000	\$0	\$200 K	\$622,500	<=1
Hailstorm	\$690 K	\$168 K	\$23,750	\$300	\$15,000	\$300 K	\$600 K	\$30 K	\$50,000	\$1.88 M	<=1
Landslide	--	--	--	--	--	--	--	--	--	--	--
Levee failure	--	--	--	--	--	--	--	--	--	--	--
River flood	\$50,000	\$5,000	\$0	\$0	\$5,000	\$5,000	\$25,000	\$0	\$25,000	\$115,000	<=1
Severe winter storm	\$1.1 M	\$560 K	\$142 K	\$100	\$1,500	\$500 K	\$1 M	\$100 K	\$1 M	\$4.4 M	0-2
Sink hole	\$10,000	\$5,000	\$4,000	\$100	\$200	\$10,000	\$20,000	\$6,000	\$10,000	\$65,300	<=1
Thunderstorm/ Lightning	\$250 K	\$112 K	\$14,250	\$200	\$500	\$150 K	\$200 K	\$3,000	\$350 K	\$1.08 M	<=1
Tornado	\$2.5 M	\$672 K	\$114 K	\$1,200	\$6,000	\$1.2 M	\$1.8 M	\$360 K	\$600 K	\$7.25 M	0-8
Windstorm	\$690 K	\$168 K	\$28,500	\$300	\$3,500	\$300 K	\$450 K	\$90,000	\$400 K	\$2.13 M	<=1
<b>Totals</b>	\$7.25 M	\$2.3 M	\$466 K	5,090	\$70,460	\$3.3 M	\$5.4 M	\$945 K	\$3.4 M	\$23.33 M	0-15

Losses are based on data from NCDC, local officials, FEMA, and the State of Iowa Hazard Mitigation Plan.

-- Hazard cannot occur in jurisdiction or does very little or no notable damage.

\* Includes public streets and bridges and public water/sewer lines as much as possible.

The natural hazards considered are estimated to have an impact of \$23,325,300 total per event as well as up to but no more than 15 fatalities in Knoxville.

**Table 7.5: Estimated Losses by Hazard Event in Melcher-Dallas (including Melcher-Dallas Schools)**

Event	Res.	Com.	Ind.	Ag. Str.	Ag. Land	Instit.	Gov. *	Ed.	Util.	Totals	Dths.
Dam failure	--	--	--	--	--	--	--	--	--	--	--
Drought	\$34,000	\$4,000	\$0	\$100	\$3,000	\$10,000	\$15,000	\$30,000	\$3,000	\$99,100	0
Earthquake	\$3,400	\$200	\$0	\$10	\$10	\$1,000	\$5,000	\$3,000	\$1,500	\$14,120	0
Expansive soils	\$50,000	\$3,000	\$0	\$50	\$250	\$7,500	\$10,000	\$15,000	\$24,000	\$109,800	0

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Extreme heat	\$34,000	\$4,000	\$0	\$100	\$1,000	\$5,000	\$5,000	\$15,000	\$24,000	\$88,100	<=1
Flash flood	\$150 K	\$12,000	\$0	\$100	\$1,000	\$25,000	\$35,000	\$25,000	\$21,000	\$119,100	<=1
Grass/wildland fire	\$25,000	\$2,000	\$0	\$200	\$10,000	\$5,000	\$10,000	\$0	\$10,000	\$62,200	<=1
Hailstorm	\$102 K	\$6,000	\$0	\$100	\$6,000	\$15,000	\$20,000	\$15,000	\$3,000	\$65,100	<=1
Landslide	--	--	--	--	--	--	--	--	--	--	--
Levee failure	--	--	--	--	--	--	--	--	--	--	--
River flood	\$5,000	\$0	\$0	\$0	\$5,000	\$0	\$20,000	\$0	\$20,000	\$50,000	<=1
Severe winter storm	\$100 K	\$20,000	\$0	\$100	\$600	\$30,000	\$50,000	\$105 K	\$60,000	\$160,700	0-2
Sink hole	\$3,400	\$400	\$0	\$100	\$100	\$1,000	\$2,000	\$3,000	\$600	\$10,600	<=1
Thunderstorm/ Lightning	\$68,000	\$4,000	\$0	\$200	\$200	\$10,000	\$25,000	\$1,500	\$21,000	\$129,900	<=1
Tornado	\$408 K	\$24,000	\$0	\$1,000	\$2,400	\$60,000	\$60,000	\$180 K	\$36,000	\$183,400	0-7
Windstorm	\$102 K	\$6,000	\$0	\$300	\$1,400	\$15,000	\$15,000	\$45,000	\$24,000	\$106,700	<=1
<b>Totals</b>	<b>\$222,800</b>	<b>\$85,600</b>	<b>\$0</b>	<b>\$2,360</b>	<b>\$30,960</b>	<b>\$185 K</b>	<b>\$272 K</b>	<b>\$153 K</b>	<b>\$248 K</b>	<b>\$2.0 M</b>	<b>0-11</b>

Losses are based on data from NCDC, local officials, FEMA, and the State of Iowa Hazard Mitigation Plan.

-- Hazard cannot occur in jurisdiction or does very little or no notable damage.

\* Includes public streets and bridges and public water/sewer lines as much as possible.

The natural hazards considered are estimated to have an impact of \$1,198,820 total per event as well as up to but no more than 11 fatalities in Melcher-Dallas.

**Table 7.6: Estimated Losses by Hazard Event in Pella (including Pella Schools, Pella Hospital, Central College)**

Event	Res.	Com.	Ind.	Ag. Str.	Ag. Land	Instit.	Gov. *	Ed.	Util.	Totals	Dths.
Dam failure	--	--	--	--	--	--	--	--	\$1 M **	\$1 M	--
Drought	\$500 K	\$174 K	\$111 K	\$5,400	\$15,000	\$200 K	\$150 K	\$200 K	\$30,000	\$1.385 M	0
Earthquake	\$50,000	\$9,000	\$7,500	\$200	\$20	\$20,000	\$50,000	\$20,000	\$15,000	\$171,720	0
Expansive soils	\$250 K	\$130 K	\$55,000	\$1,500	\$750	\$150 K	\$100 K	\$100 K	\$30,000	\$817,250	0
Extreme heat	\$500 K	\$174 K	\$111 K	\$3,600	\$3,000	\$100 K	\$50,000	\$100 K	\$240 K	\$1.282 M	0-2
Flash flood	\$1.4 M	\$400 K	\$200 K	\$5,000	\$7,500	\$400 K	\$350 K	\$250 K	\$200 K	\$3.213 M	0-2
Grass/wildland fire	\$300 K	\$150 K	\$150 K	\$36,400	\$75,000	\$100 K	\$100 K	\$5,000	\$100 K	\$1.016 M	<=1
Hailstorm	\$750 K	\$200 K	\$75,000	\$5,400	\$45,000	\$150 K	\$150 K	\$50,000	\$30,000	\$1.455 M	<=1
Landslide	--	--	--	--	--	--	--	--	--	--	--
Levee failure	--	--	--	--	--	--	--	--	--	--	--
River flood	\$50,000	\$5,000	\$0	\$0	\$5,000	\$0	\$25,000	\$0	\$25,000	\$110 K	<=1
Severe winter storm	\$1.4 M	\$500 K	\$500 K	\$1,800	\$4,500	\$500 K	\$400 K	\$100 K	\$500 K	\$3.91 M	0-2
Sink hole	\$20,000	\$10,000	\$7,400	\$200	\$300	\$15,000	\$15,000	\$10,000	\$5,000	\$82,900	<=1
Thunderstorm/ Lightning	\$300 K	\$150 K	\$50,000	\$500	\$1,000	\$150 K	\$150 K	\$6,000	\$210 K	\$1.018 M	<=1
Tornado	\$3.0 M	\$1.0 M	\$400 K	\$21,600	\$18,000	\$1.2 M	\$600 K	\$1.2 M	\$360 K	\$7.8 M	0-8
Windstorm	\$1.5 M	\$261 K	\$111 K	\$5,400	\$10,500	\$300 K	\$150 K	\$250 K	\$240 K	\$2.828 M	<=1
<b>Totals</b>	<b>\$10.0 M</b>	<b>\$3.2 M</b>	<b>\$1.8 M</b>	<b>\$87,000</b>	<b>\$186 K</b>	<b>\$3.3 M</b>	<b>\$2.3 M</b>	<b>\$2.3 M</b>	<b>\$3.0 M</b>	<b>\$26.08 M</b>	<b>0-15</b>

Losses are based on data from NCDC, local officials, FEMA, and the State of Iowa Hazard Mitigation Plan.

-- Hazard cannot occur in jurisdiction or does very little or no notable damage.

\* Includes public streets and bridges and public water/sewer lines as much as possible. \*\* Ranney Shallow Well

The natural hazards considered are estimated to have an impact of \$26,084,470 total per event as well as up to but no more than 15 fatalities in Pella.

**Table 7.7: Estimated Losses by Hazard Event in Pleasantville (including Pleasantville Schools)**

Event	Res.	Com.	Ind.	Ag. Str.	Ag. Land	Instit.	Gov. *	Ed.	Util.	Totals	Dths.
Dam failure	--	--	--	--	--	--	--	--	--	--	--
Drought	\$53,000	\$15,000	\$2,100	\$100	\$9,000	\$12,000	\$18,000	\$25,000	\$2,500	\$136,700	0
Earthquake	\$5,300	\$750	\$150	\$10	\$10	\$1,200	\$6,000	\$3,000	\$2,000	\$18,420	0
Expansive soils	\$106 K	\$11,000	\$1,000	\$25	\$500	\$9,000	\$12,000	\$15,000	\$4,000	\$51,525	0
Extreme heat	\$53,000	\$15,000	\$2,100	\$100	\$1,800	\$6,000	\$6,000	\$15,000	\$32,000	\$131,000	0-2
Flash flood	\$150 K	\$40,000	\$4,200	\$100	\$4,500	\$20,000	\$35,000	\$35,000	\$25,000	\$163,800	0-2
Grass/wildland fire	\$50,000	\$7,000	\$750	\$600	\$45,000	\$1,000	\$12,000	\$0	\$15,000	\$131,350	<=1
Hailstorm	\$150 K	\$20,000	\$1,750	\$100	\$27,000	\$18,000	\$24,000	\$15,000	\$4,000	\$109,850	<=1

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Landslide	--	--	--	--	--	--	--	--	--	--	--
Levee failure	--	--	--	--	--	--	--	--	--	--	--
River flood	\$0	\$0	\$0	\$0	\$500	\$0	\$20,000	\$0	\$1,000	\$21,500	<=1
Severe winter storm	\$150 K	\$74,000	\$10,500	\$50	\$2,700	\$36,000	\$60,000	\$50,000	\$80,000	\$313,250	0-2
Sink hole	\$10,000	\$1,500	\$140	\$100	\$180	\$1,200	\$2,400	\$3,000	\$800	\$19,320	<=1
Thunderstorm/ Lightning	\$100 K	\$14,000	\$1,000	\$500	\$900	\$12,000	\$30,000	\$1,500	\$28,000	\$87,900	<=1
Tornado	\$500 K	\$88,000	\$8,000	\$1,000	\$10,800	\$72,000	\$72,000	\$180 K	\$48,000	\$299,800	0-8
Windstorm	\$150 K	\$22,000	\$2,000	\$500	\$6,300	\$18,000	\$18,000	\$45,000	\$32,000	\$143,800	<=1
<b>Totals</b>	<b>\$171,300</b>	<b>\$308 K</b>	<b>\$32,690</b>	<b>\$3,185</b>	<b>\$109,190</b>	<b>\$206 K</b>	<b>\$315 K</b>	<b>\$208 K</b>	<b>\$274 K</b>	<b>\$1.628 M</b>	<b>0-15</b>

Losses are based on data from NCDC, local officials, FEMA, and the State of Iowa Hazard Mitigation Plan.

-- Hazard cannot occur in jurisdiction or does very little or no notable damage.

\* Includes public streets and bridges and public water/sewer lines as much as possible.

The natural hazards considered are estimated to have an impact of \$1,628,215 total per event as well as up to but no more than 15 fatalities in Pleasantville.

**Table 7.8: Estimated Losses by Hazard Event in Swan**

Event	Res.	Com.	Ind.	Ag. Str.	Ag. Land	Instit.	Gov. *	Ed.	Util.	Totals	Dths.
Dam failure	\$50,000	\$0	\$0	\$10,000	\$25,000	\$0	\$10,000	\$0	\$5,000	\$100,000	<=1
Drought	\$1,600	\$0	\$0	\$30	\$400	\$400	\$1,500	\$0	\$1,000	\$4,930	0
Earthquake	\$160	\$0	\$0	\$10	\$100	\$100	\$500	\$0	\$500	\$1,370	0
Expansive soils	\$3,200	\$0	\$0	\$25	\$100	\$300	\$1,000	\$0	\$1,000	\$5,625	0
Extreme heat	\$1,600	\$0	\$0	\$25	\$100	\$200	\$500	\$0	\$8,000	\$10,425	<=1
Flash flood	\$10,000	\$0	\$0	\$50	\$250	\$1,200	\$4,000	\$0	\$5,000	\$20,500	<=1
Grass/wildland fire	\$4,800	\$0	\$0	\$500	\$4,000	\$400	\$1,500	\$0	\$4,000	\$15,200	<=1
Hailstorm	\$8,000	\$0	\$0	\$50	\$4,000	\$600	\$2,500	\$0	\$500	\$15,650	<=1
Landslide	--	--	--	--	--	--	--	--	--	--	--
Levee failure	\$10,000	\$0	\$0	\$10,000	\$25,000	\$0	\$10,000	\$0	\$5,000	\$60,000	<=1
River flood	\$10,000	\$0	\$0	\$10,000	\$10,000	\$0	\$10,000	\$0	\$5,000	\$45,000	<=1
Severe winter storm	\$10,000	\$0	\$0	\$10	\$150	\$1,200	\$5,000	\$0	\$20,000	\$36,360	0-2
Sink hole	\$1280	\$0	\$0	\$500	\$100	\$50	\$200	\$0	\$200	\$2,330	<=1
Thunderstorm/ Lightning	\$3200	\$0	\$0	\$500	\$50	\$400	\$2,500	\$0	\$7,000	\$13,650	<=1
Tornado	\$32000	\$0	\$0	\$200	\$800	\$4,000	\$10,000	\$0	\$20,000	\$67,000	0-6
Windstorm	\$4800	\$0	\$0	\$30	\$280	\$600	\$1,500	\$0	\$8,000	\$15,210	<=1
<b>Totals</b>	<b>\$150,000</b>	<b>\$0</b>	<b>\$0</b>	<b>\$31,930</b>	<b>\$70,330</b>	<b>\$9,450</b>	<b>\$60,700</b>	<b>\$0</b>	<b>\$90,200</b>	<b>\$413,250</b>	<b>0-10</b>

Losses are based on data from NCDC, local officials, FEMA, and the State of Iowa Hazard Mitigation Plan.

-- Hazard cannot occur in jurisdiction or does very little or no notable damage.

\* Includes public streets and bridges and public water/sewer lines as much as possible.

The natural hazards considered are estimated to have an impact of \$413,250 total per event as well as up to but no more than 10 fatalities in Swan.

The above estimated data provides us a picture of the damages that could be sustained if a given event of each hazard type occurs in each jurisdiction. It is more relevant to project the annual losses by hazard by jurisdiction.

**7.3: Estimate of Losses by Hazard Per Year**

A reasonable estimate of losses can be obtained per calendar year, which would be more useful than by event, for each hazard in each jurisdiction. When using the formula, Damage per Event X (multiplied by) Number of Events Per Year, we can come up with the total losses in one year. Doing this provides a clearer picture of which hazards are likely to impact the community in a given year in terms of expected losses in today's dollars.

**Table 7.9: Estimated Losses Per Year By Jurisdiction**

Hazard	Rural *		Bussey		Harvey		Knoxville *		Melcher-Dallas *	
	#/Yr	\$/Yr	#/Yr	\$/Yr	#/Yr	\$/Yr	#/Yr	\$/Yr	#/Yr	\$/Yr
Dam failure	0.005	\$8,700	0	\$0	0.002	\$920	0	\$0	0	\$0

Marion County Multi-Jurisdictional Multi-Hazard Mitigation Plan of 2012-2016

Drought	0.2	\$700,000	0.2	\$5,786	0.2	\$2,440	0.2	\$156,160	0.2	\$19,820
Earthquake	0.005	\$1,135	0.005	\$24	0.005	\$9	0.005	\$908	0.005	\$71
Expansive soils	0.25	\$118,750	0.1	\$2,660	0.1	\$1,205	0.15	\$101,787	0.1	\$10,980
Extreme heat	0.55	\$737,000	0.55	\$11,066	0.55	\$5,940	0.55	\$495,935	0.55	\$48,455
Flash flood	0.65	\$1,963,000	0.2	\$21,970	0.2	\$10,400	0.3	\$972,000	0.2	\$23,820
Grass or wildland fire	0.9	\$412,200	0.05	\$1,960	0.05	\$1,720	0.05	\$31,125	0.05	\$3,110
Hailstorm	0.8	\$1,560,000	0.55	\$37,620	0.55	\$24,063	0.55	\$1,034,000	0.55	\$35,805
Landslide	0.3	\$9,930	0	\$0	0	\$0	0	\$0	0	\$0
Levee failure	0.02	\$18,800	0	\$0	0.01	\$2,050	0	\$0	0	\$0
River flood	0.45	\$1,251,000	0.05	\$13	0.2	\$25,200	0.05	\$5,750	0.15	\$7,500
Severe winter storm	0.65	\$644,800	0.65	\$87	0.65	\$42,705	0.65	\$2,860,000	0.65	\$104,455
Sink hole	0.2	\$28,400	0.005	\$48	0.01	\$70	0.01	\$653	0.005	\$53
Thunderstorm/Lightning	1.5	\$409,500	1.1	\$45,100	1.1	\$20,460	1.2	\$1,296,000	1.1	\$142,890
Tornado (EF2 Avg.)	0.5	\$660,000	0.1	\$14,600	0.1	\$13,400	0.12	\$870,000	0.1	\$18,340
Windstorm	0.8	\$1,384,000	0.7	\$27,230	0.7	\$16,660	0.75	\$1,597,500	0.7	\$74,690
<b>Totals</b>		\$9,907,215		\$168,163		\$167,242		\$9,421,818		\$489,989

Note: #/Yr is the total projected number of events in the jurisdiction per year, often corresponding to the probability of one event plus a second event plus additional events per year. \$/Yr is the total losses per event per year and the total losses. D/Yr is the total fatalities per year as a range.

\* Includes local schools in these jurisdictions

Hazard	Pella *		Pleasantville *		Swan		Entire County	
	#/Yr	\$/Yr	#/Yr	\$/Yr	#/Yr	\$/Yr	\$/Yr	D/Yr
Dam failure	0	\$10,000 **	0	\$0	0.002	\$200	\$9,820	<=1
Drought	0.2	\$277,000	0.2	\$27,340	0.2	\$986	\$1,189,532	0
Earthquake	0.005	\$859	0.005	\$92	0.005	\$7	\$3,104	0
Expansive soils	0.2	\$163,450	0.2	\$10,305	0.1	\$563	\$409,700	0
Extreme heat	0.55	\$705,100	0.55	\$72,050	0.55	\$5,734	\$2,081,280	0-2
Flash flood	0.3	\$963,900	0.2	\$32,760	0.2	\$4,100	\$3,991,950	0-2
Grass or wildland fire	0.05	\$50,800	0.05	\$6,568	0.05	\$760	\$508,243	<=1
Hailstorm	0.55	\$800,250	0.55	\$60,418	0.55	\$8,608	\$3,560,763	0
Landslide	0	\$0	0	\$0	0	\$0	\$9,930	0
Levee failure	0	\$0	0	\$0	0.01	\$600	\$21,450	
River flood	0.15	\$16,500	0.05	\$1,075	0.3	\$13,500	\$1,320,538	<=1
Severe winter storm	0.65	\$2,541,500	0.65	\$203,613	0.65	\$23,634	\$6,420,793	0-2
Sink hole	0.01	\$829	0.005	\$97	0.005	\$12	\$30,161	0
Thunderstorm/Lightning	1.2	\$1,221,600	1.1	\$96,690	1.1	\$15,015	\$3,247,255	0-2
Tornado (EF2 Avg.)	0.12	\$936,000	0.1	\$29,980	0.1	\$6,700	\$2,549,020	0-2
Windstorm	0.75	\$2,121,000	0.7	\$100,660	0.7	\$10,647	\$5,332,387	<=1
<b>Totals</b>		\$9,808,788		\$641,646		\$91,064	\$30,685,924	0-6

Note: #/Yr is the total projected number of events in the jurisdiction per year, often corresponding to the probability of one event plus a second event plus additional events per year. \$/Yr is the total losses per event per year and the total losses. D/Yr is the total fatalities per year as a range.

\* Includes local schools in these jurisdictions \*\* No dam failures in city but shallow well serving city can be impacted.

While not perfect, the loss estimation tables give us an idea what to expect in terms of losses by jurisdiction and hazard, even though we do not know exactly which buildings will be damaged the most. By estimating losses and annualizing the results for natural disasters, we have a means to prioritize hazards and mitigation actions beyond the basic profile results. Using this methodology, we find that the total annual loss to natural disasters in today's dollars is approximately \$30 million dollars. This would include land, buildings, infrastructure, livestock, and crops. This figure is higher than what has been reported as losses in the average year because it is likely that many of the losses are not reported to appropriate officials.

It is much more difficult to project annualized fatalities. The potential for losses is great in a given year, but fatalities vary greatly from year to year and from event to event. The data showing up to 6 fatalities in one year is simply a benchmark.

The State Mitigation Plan adopted in 2010 includes loss estimations models and processes for 11 natural hazards and one man-made hazard: flooding, drought, crop loss, tornado, hail, thunderstorm, extreme cold, snow and ice, windstorm, earthquake, lightning, and extreme heat. For each hazard the State plan has a description of an estimation methodology and historical loss data used in the models.

**Table 7.10: State Hazard Mitigation Plan Loss Information**

Juris.	Flood	Drought	Crop Loss	Extreme Heat	Extreme Cold	Hail
Marion	\$13,073,882.35	\$2,986,433.93	\$646,635.33	\$3,000.00	\$283,375.00	\$40,187.50
Iowa	\$1,054,733,588.24	\$177,000,000.00	\$75,668,861.11	\$390,062.50	\$17,672,437.50	\$32,404,937.50
Percent	1.24%	1.69%	0.85%	0.77%	1.60%	0.12%

Juris.	Snow & Ice	Tornado	Lightning	Thunderstorm	Windstorm	Total
Marion	\$279,138.50	\$38,400.00	\$588.24	\$126,529.41	\$60,321.01	\$17,538,491.27
Iowa	\$9,916,799.62	\$37,230,550.00	\$730,117.65	\$23,169,429.41	\$4,249,224.34	\$1,433,166,007.86
Percent	2.81%	0.10%	0.08%	0.55%	1.42%	1.22%

Source: State of Iowa Hazard Mitigation Plan, 2010

It is very difficult to compare the State’s loss estimates to those presented in this plan because the hazards are categorized differently. For example flooding is not separated by type, lightning is separated from thunderstorms, and extreme cold and snow & ice are expanded from winter storms. However, if we were to utilize this data in its current form, we’d find that the State of Iowa’s loss estimate for these hazards to be just over half as high as the total loss estimate found in this plan. Some hazards are reasonably similar in losses per the estimations, but other hazards, such as flooding (State value much higher), drought (State value more than double), extreme heat (State value is much, much lower), severe winter storm (State value much lower), thunderstorm and lightning (State value much lower), tornado (State value much lower), and windstorm (State value much, much lower) differ much. This does not suggest that the State values are inaccurate, but that the process is relatively subjective, that it is difficult to forecast precise losses when hazard events vary so much across the entire state, that data sources differ, and that there are many more assets to consider at the state level.

**7.4: Data Limitation and Corrective Actions**

The value and population tables in *Chapter 6* helped to develop reasonable estimates, but more precise study in the future will be needed– likely after a national loss estimation table is made for each of the above hazards. It should be noted that these losses are based on current mitigation strategies.

The above tables only represent natural hazards. This does not mean that no other hazards will damage the communities and the county. Certainly, highway transportation incidents and structural fires can and will cause deaths almost every year in Marion County. Other incidents, such as terrorism events and structural failure, could cause mass casualties, but cannot be predicted with any real certainty. As a baseline figure, it may be useful to assume that the annual loss estimate due to non-natural hazards is approximately equal to the total natural hazard loss level. This assumption would indicate that the total hazard-related losses would be up to 12 deaths and \$60 million in damages per year. If FEMA provides more guidance for the estimation of losses for non-natural hazards in the future, the plan update could include such estimates.

The above loss tables are not for insurance purposes or detailed planning and budgeting. At best, the tables should be used for comparison purposes when developing goals and objectives. Losses that cannot be included in such tables are considerations such as emotional anguish, losses of records and unique items, losses to pristine forests, water quality deterioration, and pollution creation. For many hazards a large area is at risk, but damage to any property will be very limited, and hazard effects would be mostly economic and operational. Most natural hazard events will impact individual buildings rather than all properties, and the percentages indicate the approximate impact to property. Items like water and sewer systems may or may not be damaged by an event, and it may be difficult to determine whether the deterioration of underground systems is due simply to age or from hazard impacts over the years.

### **7.5 Land Use Trends, Development Plans, and Losses**

We have previously discussed (*Chapter 6*) the specific growth, land use and population trends in the community. The above loss analysis doesn't consider new development. Therefore, an additional 1% could be added to the countywide loss estimation table for each year due to new construction in the county and certain jurisdictions in the county. Special consideration in this assumption should be given to wildland fires, as they are more likely to impact new construction on the fringe of forest and agricultural areas. The percentage impact of wildfires would be higher, and losses by wildfires in new development areas could be more than 5% greater than the losses experienced in other areas of the county over the next 20 years. Most of the area impacted would be agricultural land that was taken out of production and would be subject to more losses due to the increased value of new structures on the property. Most small towns, some older neighborhoods of the larger towns, and the remote parts of the county are not expected to experience notable levels of development, and would not be included in such estimates.

### **7.6: Summary**

The hazard mitigation planning team indicates that the main disaster losses over the past five years have been outbuildings, terraces, some grain bins and silos, overhead power lines, and many roads and bridges. Roads have sometimes been closed for days at a time when bridges have been destroyed, causing significant economic losses.

No single hazard event has potential impacts that are expected to cause extraordinary damage in the county, with the exception of a major tornado event or a complete dam failure at Lake Red Rock. The impacts per event, and thus per year, could be reduced if mitigation measures are in place.

Priority mitigation actions can and should be based upon relative loss data, but we should not place too much emphasis on these criteria and should carefully to consider hazard profile information and assets at risk as well.