



## I. Introduction

Figure 1 provides the basis for the case study. This is a view of a stream that is in the early stages of down-cutting and it is beginning to erode the outside bend in the stream. These real-life stream conditions continue to be exacerbated by changing climate conditions. Across the country we continue to see more frequent intense storms occurring with short recurrence periods. These storms typically discharge large volumes of precipitation in shorter periods of time. This then causes large run-off volumes to be conveyed through stream segments that are already in need of restoration. Further adding to the run-off discharge volumes is the continued development within the watersheds, that increase the impervious areas, which then changes the time it takes the peak flows from entering the streams. These peak flows reach the stream faster than they had in the past. This, coupled with the increased storm frequency and intensity, contributes negatively to the continued stability of the stream.

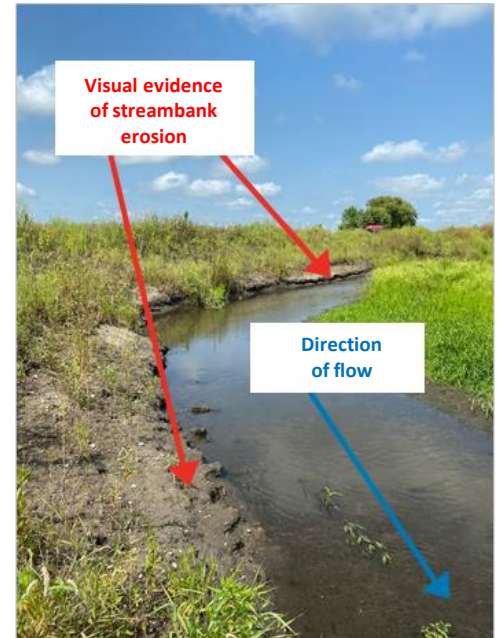


Figure 1: Existing stream bank conditions at project site.

## II. Challenges

These streambank conditions continue to exist in both rural and urban settings nationwide. With the continued stress of climate change on weather patterns, local climates and economic pressure associated with development, the future of stream and channel stability is an ongoing challenge. For this case study, the restoration includes 60 linear feet of streambank. Figure 3 provides information on the location of the restoration. This segment was selected as it is upstream of the bend in the stream. By restoring this segment, the likelihood of reducing the bank erosion immediately downstream is minimized. Migrating the flow more towards the center of the channel will also help to fully migrate the flow to the center, a “J” hook structure should be installed at the downstream end of the restoration segment. This not only migrates the flow towards the center, but it protects the restoration segment and allows it to stabilize and establish vegetation.

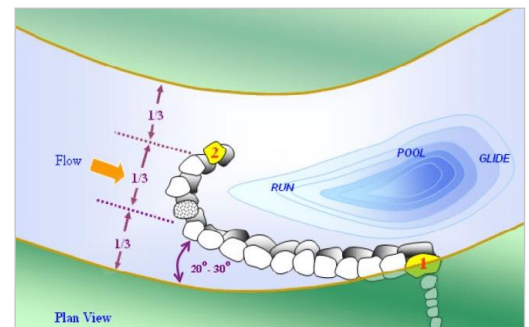


Figure 2: “J” Hook image courtesy of US Fish and Wildlife Service.

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Figure 3: Limits of project resources

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## III. Project Team

Technical Lead	Installation Contractor	Product Manufacturer
<p>JEO Consulting Group</p> <p>11213 Davenport Street, Suite 200</p> <p>Omaha, Nebraska 68154</p> <p>Contact: Mark McCabe</p> <p>E-Mail: <a href="mailto:mmccabe@jeo.com">mmccabe@jeo.com</a></p> <p>Phone: 740-497-0747</p>	<p>B &amp; L Seeding, LLC88</p> <p>Highland Ave</p> <p>Dumont, IA 50625</p>	<p>American Excelsior Company</p> <p>850 Avenue H E</p> <p>Arlington, Texas 76011</p>

## IV. Restoration Plan and Installation

It was determined that the Curlex® Bloc was to be used as the primary feature for the restoration after assessing pre-project data. This data included survey results from above via drone technology and ground level digital photos. The benefits of using the Curlex® Bloc as the main feature of the restoration include:

- Allows for greater stability and soil contact
- Increased buffering capacity of flow velocity
- Bloc allows for direct planting through the matrix
- Promotes healthier vegetation growth
- Native to North America

Curlex® Bloc installation is completed in a series of steps. Site preparation is followed by placement of the Curlex® Bloc, securing the Blocs to the bank, and vegetating the installation. The installation process is described below.

### Step 1: Preparing the Restoration Area to Receive the Curlex® Bloc

This step required preparing the restoration area for placement of the Blocs. Figure 4 shows bank preparation using hand tools to form a level bench for placement of the Blocs. Note the vertical nature of the stream bank wall. This is necessary to achieve maximum contact between the bank and the Blocs and minimize any large voids the flow could get behind and cause erosion. Figure 5 shows the bank area prepared for Bloc placement.



Figure 4: Streambank excavation and preparation.



Figure 5: Restoration area ready for Block installation

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## Step 2: Curlex® Bloc Assembly and Installation

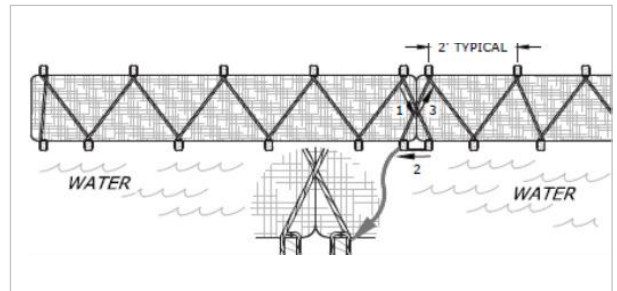
This step requires assembling Curlex® Bloc in 8' lengths. Each Bloc includes a sleeve at each end of the Blocs that needs to be fitted over the next Bloc to form the connected length for the restoration. Fitting the Blocs together was a bit challenging given the length and weight of the Blocs, however once they were lined up and butted together they formed a gapless joint between the Blocs. This step is optional, but does provide the best joint option. Figure 6 shows the Blocs being fit together with sleeves.



**Figure 6: Fitting two Curlex® Blocs together.**

## Step 3: Anchoring Curlex® Bloc in Place to Form the Restoration

This step requires securing the Blocs into the excavated restoration area. The anchoring pattern requires 2 foot spacing with anchors placed on both sides of the Curlex® Bloc along the water face and bank face, driven a minimum of 2 feet into the ground. Figure 7 shows the anchor system installed. Once the anchor stakes are placed, rope was located per the anchoring techniques detail.



**Figure 7: Curlex® Blocs anchoring detail.**

## Step 4: Placing Live Stake Vegetation into Curlex® Bloc

This step required placing live stakes along the length of the Bloc. Once these begin to establish root systems they will overtake the Bloc and form natural protection along the bank reducing future degradation of the bank. Figure 8 illustrates the planted Curlex® Bloc.



**Figure 8: Curlex® Bloc with live stakes inserted.**

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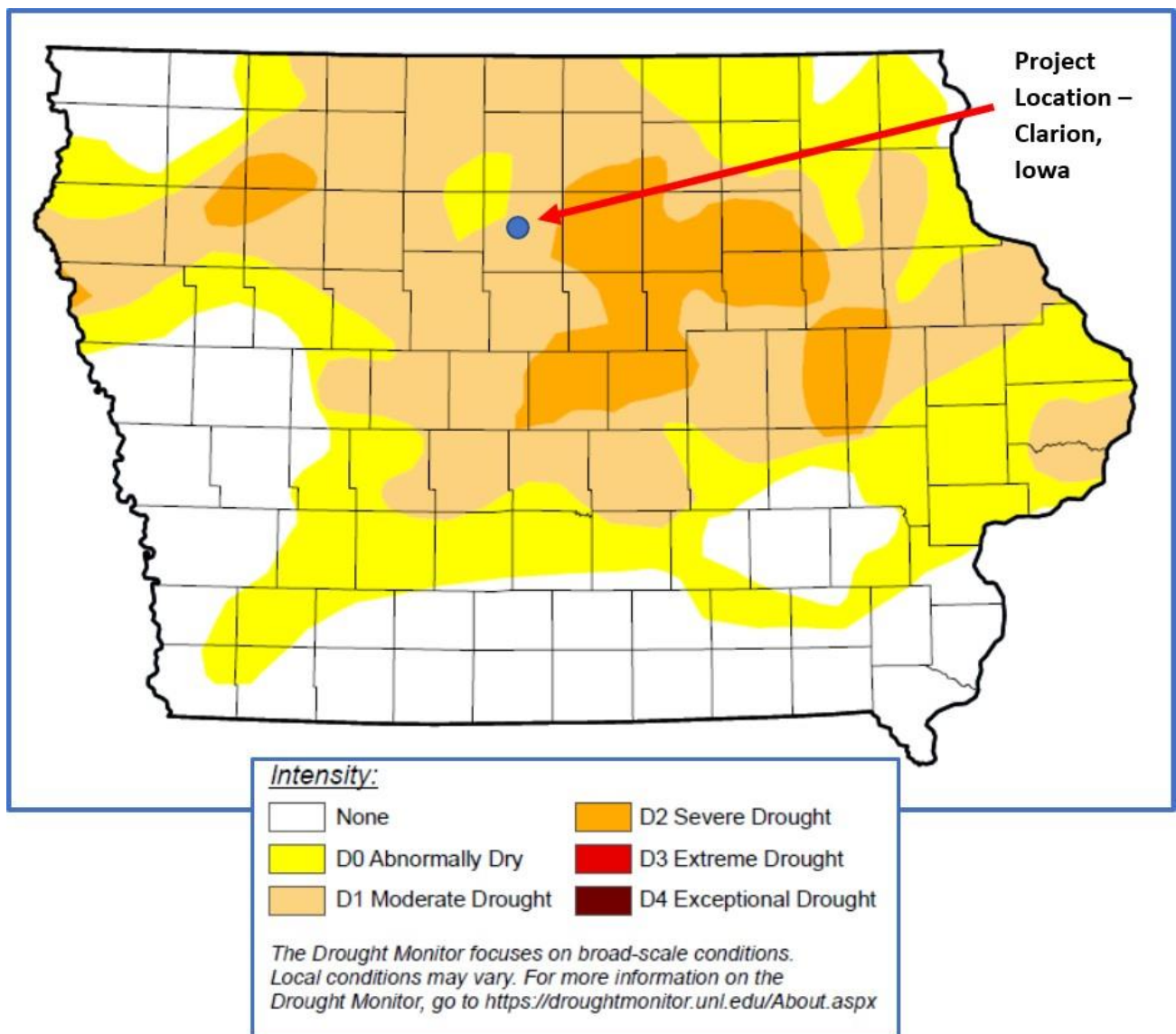
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## V. Project Area Drought Conditions

The restoration site in Clarion, Iowa has been experiencing abnormally dry to moderate drought conditions throughout 2021. Figures 9 and 10 are graphics developed using data and information from the US Drought Monitoring Center. They show drought conditions in Iowa on September 7, 2021 when the project was constructed and the drought conditions on October 5, 2021 prior to the field inspection to document vegetation establishment.

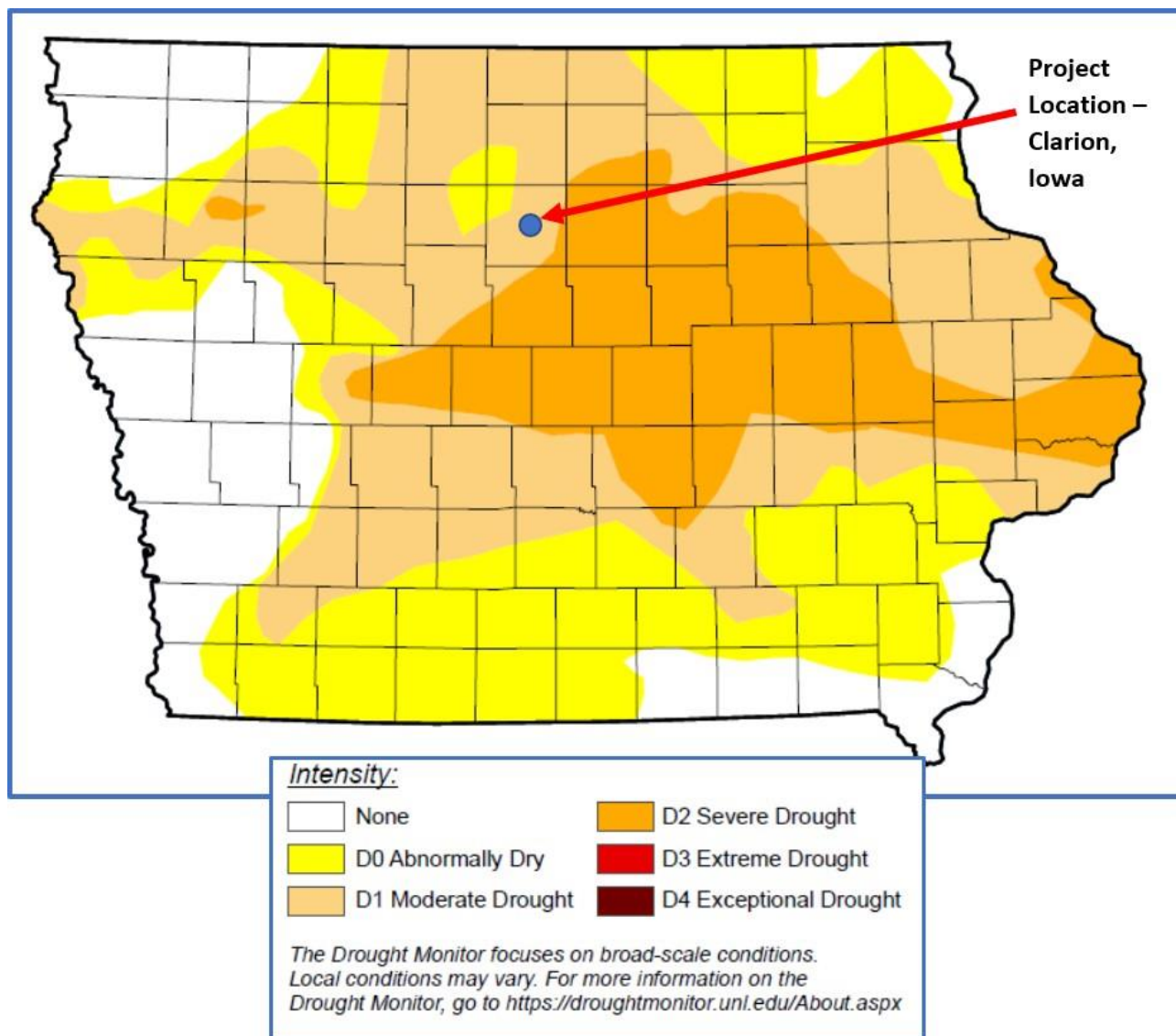


**Figure 9: September 7, 2021 Drought Monitor Status for Iowa.**

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**Figure 10: October 5, 2021 Drought Monitor Status for Iowa.**

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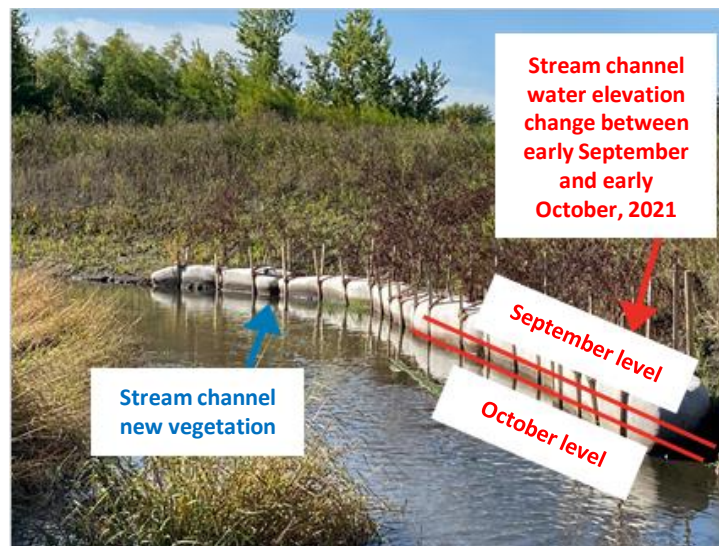


Figures 11 and 12 show the condition of the live staking as it looked during the October 5, 2021 field inspection. There are several items worth noting in the figures:

- Note the condition of the live staking.
- Note the establishment of vegetation in front and behind the Curlex® Blocs.
- Note the change in stream water level from the installation in early September to early October.



**Figure 11: Vegetation establishment behind Blocs and live staking.**



**Figure 12: October 5, 2021 Water level change and vegetation growth in the channel.**

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## VI. Summary

The Curlex® Bloc product used for the restoration provided the following benefits:

- Installation required minimal excavation and grading.
- Installation only required two people to coordinate placement of the Curlex® Bloc properly into the prepared area.
- The drought conditions in Clarion, Iowa presented a challenge for establishing and maintaining the live stakes inserted into the Blocs, but the moisture retention of the Blocs helped get through the tough drought conditions.
- New vegetation was noted in the stream in front of the Blocs and also behind the Blocs along the bank. If needed, additional live staking will be added in the spring of 2022.
- Post-installation lesson learned: JEO should trim down the tie-down stakes to minimize any debris from collecting on them during high flow events. This will also reduce the risk of wildlife becoming injured on the tie-down posts.
- Photographs will collected during Spring of 2022 to document stability during expected high flows.
- Spring 2022 site visits will provide information on the condition of the banks both upstream and downstream of the restoration to document the condition of the bank at the transition of the natural bank material and installed Curlex® Bloc sections.

*A follow up on this case study will be issued in the Spring of 2022.*