2018 CITIZEN SCIENCE RUSSIAN OLIVE MONITORING QUALITY ASSURANCE AND QUALITY CONTROL REPORT CITY OF CASPER, CASPER, WY

December 20, 2018

Project #: 13A-005-001

SUBMITTED BY: Trihydro Corporation

707 West 1st Street, Casper, WY 82601

PREPARED FOR: City of Casper

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1.0 INTRODUCTION

In 2017, the City of Casper (City), Wyoming determined that a Citizen Science Program (Program) should be developed to support ongoing riparian restoration efforts along the North Platte River. This Program was conceived of as a natural extension of the Platte River Revival, which is a riparian habitat enhancement project that is driven by a partnership of private organizations and government agencies. The Platte River Revival is strongly supported by volunteers who have contributed to its diverse activities during annual Volunteer Day hosted in September. The focus of the Program is monitoring for Russian olive (*Elaeagnus angustifolia*) regrowth within Platte River Revival restoration project areas.

The Program was implemented on September 23, 2017. Following the implementation of the Program, Trihydro Corporation (Trihydro) conducted a quality assessment of the data collected, on behalf of the City, to determine the efficacy of the data collection process. A Quality Assurance and Quality Control (QA/QC) Report was developed to summarize the data that were collected within three Weed Management Areas (WMAs) in 2017, evaluate the quality of the data collected using the Program, and review the Program's approach following the first year of implementation to identify potential changes that could be made to enhance its efficacy and efficiency (Trihydro 2017). The QA/QC process is an essential component of all Citizen Science programs, as it represents a key step in the development of the program, during which confidence in the data and approach is assured. Results of the 2017 QA/QC Report indicated that data collected by Citizen Scientists and data collected by a contracted biological consultant were 83% similar, which is a relatively high level of agreement (Kosmala et al. 2016). The purpose of this report is to present the results of the QA/QC analysis of one of the WMAs surveyed during the 2018 Volunteer Day (WMA 4, Casper Well Field).

2.0 CONTINUED DEVELOPMENT OF THE CITIZEN SCIENCE PROGRAM

Comments received from the City Staff and Platte River Revival partners, who provided leadership to Citizen Scientists during the 2017 Volunteer Day Citizen Science data collection effort, were also an integral part of refining the Program. Following the 2017 Volunteer Day, City staff who participated in the data collection event were asked to provide comments regarding potential improvements to the Program. As a result of collaborative participant discussions, the City of Casper updated the Collector App (App) schematic and the associated Systematic User Guide (i.e., field guide) prior to the 2018 Volunteer Day. The revisions emphasized a more streamlined approach to collecting field data, by limiting the amount of information entry required on the App.

The revised schematic and Systematic User Guide are provided in Appendix A and Appendix B, respectively. A Procedural Document was developed in 2017 to accompany the Systematic User Guide and outlined detailed methods for field data collection. The Procedural Document developed in 2017 is provided in Appendix C. The general field data collection methods outlined in the 2017 Procedural Document were utilized in 2018, with the exception of updates to the schematic and Systematic User Guide.

3.0 METHODS

3.1 IDENTIFYING RUSSIAN OLIVE

To structure the surveying approach and recording of data, each of the City's 19 WMAs were divided into approximately 100 square yard subsections. The resulting grid was overlaid onto a map available on the App, so users (City staff and/or Citizen Scientists) could identify which subsection they were surveying within a WMA. In September 2018, the QA/QC emphasized the assessment of one WMA, the Casper Well Field (WMA 4). Citizen Scientists were tasked with identifying the presence or absence of Russian olive within each subsection of the WMA. Prior to conducting any surveys, City staff briefed Citizen Scientists on how to identify Russian olive. The data recording process is detailed below.

3.2 RECORDING DATA

Within each subsection, Citizen Scientists recorded one of two point features, which indicated either the presence or absence of Russian olive. In the event that Russian olive was determined to be present, additional attributes were recorded to characterize the extent (single tree or size of stand, as applicable). Other attributes included, but were not limited to, date, landscape description, and user notes (Appendix A). The specific approach to collecting data is outlined further in the Systematic User Guide (Appendix B). It is important to note that an unlimited number of data points could be collected from any given subsection to reflect the numerous Russian olive trees and/or stands of trees found within it. In the event that no Russian olive was observed, a single "absent" record was made for a subsection. The results of the data collected during the Program are detailed in Section 4.0.

3.3 QUALITY ASSURANCE / QUALITY CONTROL

To determine the quality of the data collected by Citizen Scientists during the Volunteer Day, a biologist applied the same methodology outlined in the Systematic User Guide to survey a sample of the subsections surveyed during Volunteer Day that were randomly selected by the City of Casper. Approximately 15% of the subsections where Citizen Scientists identified Russian olive were selected for the QA/QC event. Similarly, approximately 15% of subsections in which Citizen Scientists identified no Russian olive were selected for the QA/QC event. To avoid potential bias, the data, displayed on Figure 1, were not made available to the biologist until the conclusion of the QA/QC fieldwork. In total, the randomly selected subsections comprised approximately 20% of the total WMA and were spatially distributed throughout the confines of the WMA boundary. While data quality is multi-dimensional and can therefore be based on a number of metrics (Kosmala et al. 2016), the emphasis for this assessment was based on accuracy because the data produced by the Program must have a high level of accuracy if it is to be informative and useful in making Russian olive treatment decisions in the future. Thus, high quality data produced by Citizen Scientists are data of comparable accuracy to data produced by professionals (i.e., the contracted biologist; Bonney et al. 2014). In the event that the datasets did not agree, potential causes for discrepancies were further investigated by referencing the data attributes (e.g., user notes). The results of the QA/QC are detailed in Section 4.0.

4.0 RESULTS

4.1 2018 CITIZEN SCIENCE PROGRAM

The 2018 Citizen Scientist data collection in WMA 4 resulted in the survey of 345 subsections. Within WMA 4, 29 subsections were identified with Russian olive and in the remaining subsections, no Russian olive was identified (Figure 1). Seventeen single immature trees and seventeen immature stands were identified during the 2018 Program (Table 1). In addition, one mature tree and one mature stand of trees were identified in WMA 4 (Table 1).

4.2 2018 QUALITY ASSURANCE / QUALITY CONTROL

A total of 63 randomly selected subsections were selected by the City to be surveyed by a biologist during the 2018 QA/QC event. The biologist identified 16 subsections with Russian olive, and 47 subsections without Russian olive within the WMA. Table 2 displays the data collected by the Citizen Scientists and the contracted biologist. There were 11 subsections where the Citizen Scientist results did not agree with the biologist results (Figure 2). Citizen Scientists identified Russian olive in one subsection that was determined to lack Russian olive during the QA/QC event. Conversely, 10 subsections were determined to have Russian olive during the QA/QC event, which were previously determined by Citizen Scientists to lack Russian olive (Figure 2).

For the purposes of this Project, similarity refers to the level of agreement between two datasets. Accuracy is used almost synonymously but recognizes one dataset as the correct baseline for comparison (i.e. contracted biologist). The accuracy is the degree to which the data in question (i.e. Citizen Scientist data) is correct, compared to the baseline data collected by the contracted biologist. Because there is not a third database to serve as a control for comparison, the terms, “accuracy” and “similarity” are used interchangeably in this report. The overall level of agreement between the two datasets was 83%, which indicates a high level of accuracy (similarity) in determining the presence or absence of Russian olive within an individual subsection (Table 2). This level of accuracy is based on the statistic that data collected by two or more professional scientists may have a 77% to 87% similarity, depending on the type of data being collected (Kosmala et al. 2016).

Further investigation into the user notes in both datasets suggests that inaccuracies in sampling may occur when assessing immature trees. Small, immature trees may be easily overlooked. And, only one tree within a stand may have been identified by Citizen Scientists. Other potential causes for discrepancies, such as identification error, were not an issue. For instance, silver buffaloberry (*Shepherdia argentea*) is often misidentified as Russian olive, but the Citizen Scientists correctly distinguished between these species, further justifying the high level of accuracy collected during the Program.

Similarity between datasets was lower for finer-scale data features with more subjectivity. For example, the dataset produced by Citizen Scientists and City staff contains a greater number of individual trees and fewer stands of trees compared to the dataset produced from the QA/QC event. This trend was also exhibited in the 2017 QA/QC Report (Trihydro 2017). Because each stand represents at least two trees, the data collected by Citizen Scientists may underestimate the amount of Russian olive trees within each WMA. However, identifying the correct age and location of trees may have more utility than correctly identifying the quantity. For instance, equipment necessary for removing single immature trees would be the same equipment used to remove immature stands. Therefore, while the Program will prove useful during the planning phase of removal efforts, it should be recognized that data limitations are associated with the quantity of trees recorded, which may ultimately underestimate the cost of labor.

5.0 CONCLUSIONS

5.1 CITIZEN SCIENCE PROGRAM

During the 2018 Platte River Revival Volunteer Day, data were collected to characterize 345 subsections within WMA 4 in one day. The identification of predominately immature, single trees and stands suggests that the ongoing treatment efforts in the WMA has been successful in reducing the extent of Russian olive. Similarly, the data indicate that the majority of the remaining Russian olive trees within the WMAs may be treated without the use of labor-intensive mechanical treatments (e.g., chainsaw, backhoe, etc.). In addition, these data provide a relatively precise location of each tree or stand that has been identified, which allows treatment efforts to target specific trees and locations, rather than requiring treatment personnel to search throughout an entire WMA to identify and treat a relatively small number of trees or stands.

Data collected at the level of the subsection can be effectively used to develop a follow-up treatment plan for a WMA. The characterization of individual trees and stands can assist with defining the treatment plan work scope as well as providing a more fine-scale understanding of the relative cover and abundance of Russian olive trees within a WMA. The data collected can also be used to compare WMAs in terms of the current number and extent of trees that remain following treatments events, which will aid in understanding the effectiveness of treatments.

5.2 PROGRAM EFFICACY

The quality review of the 2018 data collected by Citizen Scientists indicates that the approach implemented effectively achieves the Program's goals. A total of 345 subsections were surveyed in 2018, and approximately 83% of these subsections were assessed the same as the QA/QC biologist. This level of agreement is considered to be high, as data collected by professional scientists can be characterized by a 77% to 87% similarity, depending on the type of data being collected (Kosmala et al. 2016). Following revisions to the schema and Systematic User Guide, it was anticipated that field data collection would be expedited and potential causes for discrepancy would be reduced, resulting in a higher level of agreement between the datasets. The revised approach to data collection did reduced the time necessary to collect each point but did not result in greater level of agreement. Notably, while accuracy was anticipated to increase in 2018, no decrease in quality occurred, and Citizen Scientists were able to retain high accuracy (83% [the same as 2017]) while expediting field data collection.

The revised schema was designed to limit the amount of time spent recording data into the App. Despite this streamlined approach, there was no compromise in quality. The high similarity between datasets for this Program is likely due to the binary nature of the data and the training provided to Citizen Scientists regarding the identification of this species. The repeatability of the high level of accuracy is an indication that the Program produces an accurate dataset, while providing the community with opportunities to participate in the Platte River Revival Volunteer Day activities.

6.0 REFERENCES

Bonney, R., J.L. Shirk, T.B. Phillips, A. Wiggins, H.L. Ballard, A.J. Miller-Rushing, and J.K. Parrish. 2014. Next steps for citizen science. Science 343: 1436-1437.

Kosmala, M., A. Wiggins, A. Swanson, and Brooke Simmons. 2016. Assessing data quality in citizen science. Frontiers in Ecology and the Environment 14: 551-560.

Trihydro Corporation. 2017. Citizen Science Russian Olive Monitoring Quality Assurance and Quality Control Report, City of Casper, Casper, WY.

TABLES

TABLE 1. 2018 CITIZEN SCIENCE PROGRAM SUMMARY
CITIZEN SCIENCE RUSSIAN OLIVE MONITORING
QUALITY ASSURANCE AND QUALITY CONTROL REPORT
CITY OF CASPER, CASPER, WY

Weed Management Area	Total Number of Subsections Surveyed	Russian Olive Absent (total subsection count)	Russian Olive Present (total subsection count)	Immature, Single Tree (total data point count)	Mature, Single Tree (total data point count)	Immature Stand (total data point count)	Mature Stand (total data point count)
4, Treated	345	316	29	17	1	17	1

Note: Several individuals or stands may be present in each subsection, so the total data point counts may not sum to the total subsection count.

TABLE 2. 2018 QUALITY ASSURANCE QUALITY CONTROL RESULTS
CITIZEN SCIENCE RUSSIAN OLIVE MONITORING
QUALITY ASSURANCE AND QUALITY CONTROL REPORT
CITY OF CASPER, CASPER, WY

WMA Survey Event	WMA	Total Subsection Count	Russian Olive Absent (total subsection count)	Russian Olive Present (total subsection count)	Immature, Single Tree	Immature Stand	Mature, Single Tree	Mature Stand	*Dataset Discrepancies Identified (total subsection count)	*Dataset Similarity
Citizen Science Program	4, Treated	63	56	7	6	6	2	0	11	83%
QA/QC (Biological Consultant)	4, Treated	63	47	16	14	8	0	0		

Notes:

WMA = Weed Management Area

QA/QC (Biological Consultant) = Quality Assurance/Quality Control. These data were collected by a contracted biological consultant.

*Discrepancies reflect subsections in which Citizen Scientists collected presence/absence data that differed from the presence/absence data collected by the biological consultant. Discrepancies have been summed to arrive at a total value. The number of discrepancies for a WMA is likely not simply the difference between the Citizen Scientists total count for the category of Russian olive present and the biological consultant total count. This is because total observations do not necessarily reflect discrepancies on a case by case basis when there are two alternatives available for a feature (present or absent). For instance, a Citizen Scientist may record Russian Olive at 10 subsections, but they may not be the same 10 subsections recorded by the Biological Consultant. The resulting discrepancy information was analyzed to help determine how accurate the data collected by Citizen Scientists may be. The QA/QC indicated that 11 discrepancies were identified within the 63 subsections sampled, resulting in a 83% similarity between the QA/QC dataset and the Citizen Science Program dataset.

FIGURES

NOTE:

A GRID-WORK WAS OVERLAID ONTO EACH WMA, CREATING SUBSECTIONS FOR SURVEYING. EACH SUBSECTION IS APPROXIMATELY 100 SQUARE YARDS IN SIZE.

Casper Well Field

Source: Esri, DigitalGlobe, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AeroGRID, IGN, and the GIS User Community

EXPLANATION

VOLUNTEER SURVEY

- NO RUSSIAN OLIVE PRESENT (316)
- RUSSIAN OLIVE PRESENT (29)

WEED MANAGEMENT AREA

- CASPER WELL FIELD (WMA 4)

N

0 400'

Trihydro CORPORATION
1252 Commerce Drive
Laramie, WY 82070
www.trihydro.com
(P) 307/745.7474 (F) 307/745.7729

FIGURE 1

CASPER WELL FIELD SURVEY (WMA 4)
CITIZEN SCIENTIST MONITORING

NORTH PLATTE RIVER MONITORING
CITY OF CASPER, WYOMING

Drawn By: BR	Checked By: SJ	Scale: 1" = 400'	Date: 11/15/18	File: Casper_RussianOlive2018.aprx

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NOTE:

A GRID-WORK WAS OVERLAID ONTO EACH WMA, CREATING SUBSECTIONS FOR SURVEYING. EACH SUBSECTION IS APPROXIMATELY 100 SQUARE YARDS IN SIZE.

EXPLANATION

BIOLOGIST SURVEY
- NO RUSSIAN OLIVE PRESENT
- RUSSIAN OLIVE PRESENT

VOLUNTEER SURVEY
- NO RUSSIAN OLIVE PRESENT
- RUSSIAN OLIVE PRESENT

SURVEYED GRID CELL
- DATASETS AGREE (52)
- DATASETS DISAGREE (11)

WEED MANAGEMENT AREA
- CASPER WELL FIELD (WMA 4)

Casper Well Field

Source: Esri, DigitalGlobe, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AeroGRID, IGN, and the GIS User Community

N

0 400'

Trihydro CORPORATION
1252 Commerce Drive
Laramie, WY 82070
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FIGURE 2

**CASPER WELL FIELD SURVEY (WMA 4)
BIOLOGIST AND CITIZEN SCIENTIST
FIELD SURVEY DATA AGREEMENT**

**NORTH PLATTE RIVER MONITORING
CITY OF CASPER, WYOMING**

Drawn By: BR	Checked By: SJ	Scale: 1" = 400'	Date: 11/15/18	File: Casper_RussianOlive2018.aprx

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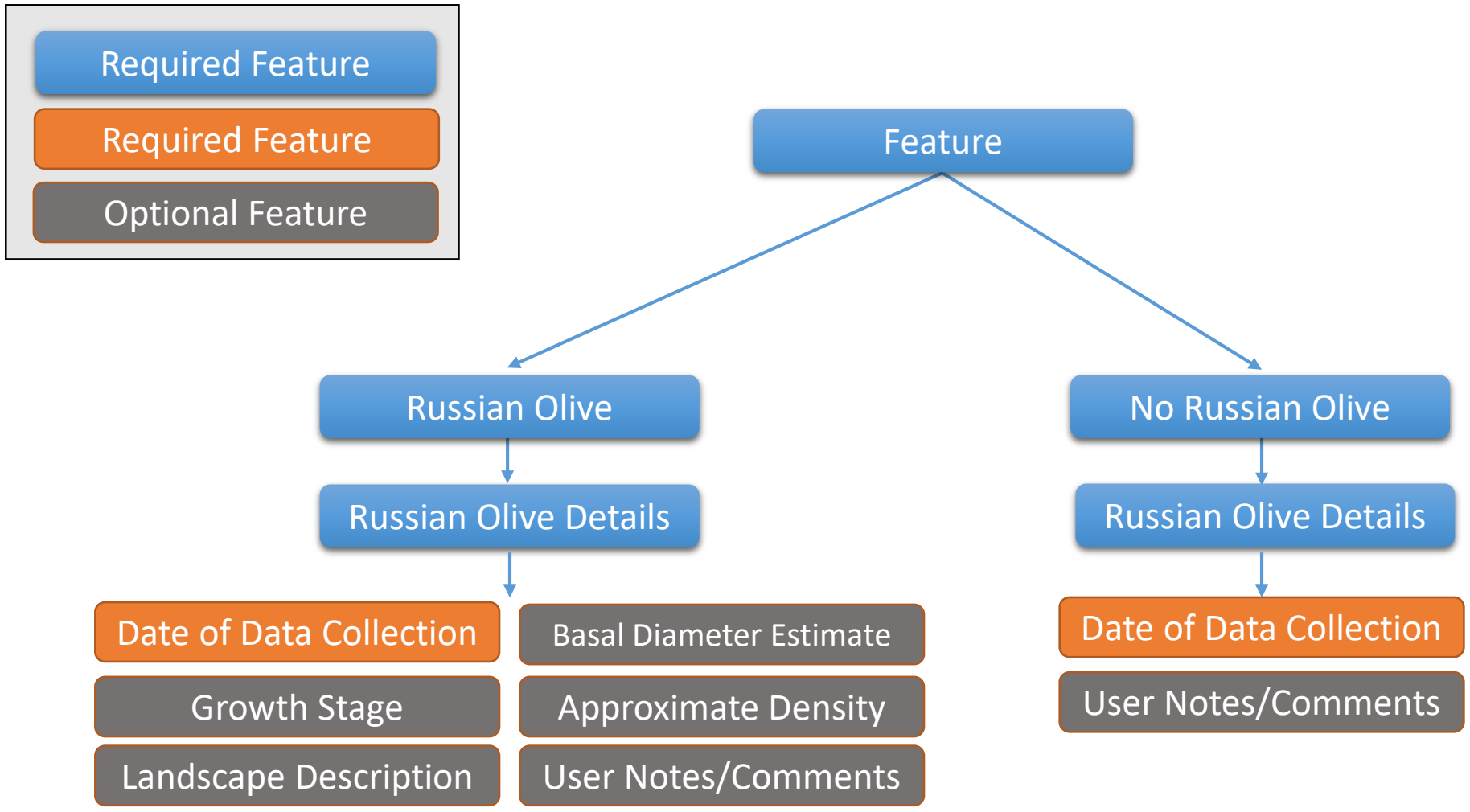
APPENDIX A

REVISED COLLECTOR APP SCHEMATIC

APPENDIX A. REVISED COLLECTOR APP SCHEMATIC
2018 CITIZEN SCIENCE RUSSIAN OLIVE MONITORING QUALITY ASSURANCE AND QUALITY CONTROL REPORT, CITY OF CASPER, CASPER, WY



APPENDIX B

REVISED SYSTEMATIC USER GUIDE

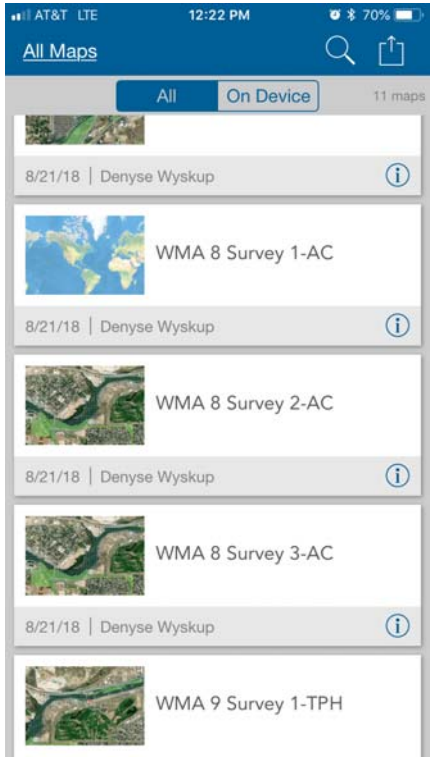
Using the Collector App

Login In:

Open the App, and enter user name and password

Selecting Basemap:

Select the basemap that has been assigned to you for the Russian olive survey. You will be able to recognize the area boundaries by the abbreviation at the end of the basemap name.



You will be assigned your own map depending on the Weed Management Area (WMA) you are working in. You will be able to see observations made by other users working in the same WMA in your map in real time.

Spatial Orientation:

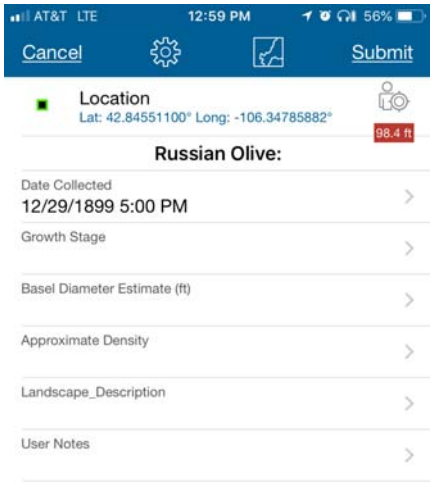
The area will be broken into grid squares. Your location on the map will be shown as a blue dot. You can use two fingers to zoom in and out on the map. Zoom in until you can see the labels for each grid square. If you pan off your location simply press the position button to center on your location (red arrow).

Recording Data:

If you have found a Russian Olive, select the add feature icon, represented by a "+", (under the time on the image above) collect a new feature. The "+" icon allows you to collect a feature at your current location, ensure that you are standing near the location of the Russian Olive. Then select "Russian Olive".

Russian olive was found:

This is what you will see:



None of the fields are required for an observation to be made, but the more information that you can input the more useful the observation will be.

At a minimum please complete the date and growth stage. You can select the "today" button under the date collected. Growth Stage will be "Immature" if the tree can be bent side to side by hand.

Additional information to provide if relevant:

Basil Dimeter, estimated diameter of the trunk at its base. Approximate Density, if there is more than one tree of similar size within 30 feet of each other it should be observed as a stand. If there is anything out of the ordinary about where the tree is growing that could make it difficult to remove or treat you can note that in Landscape Description. If the observation was a stand please provide the approximate number of trees in the stand and any other information that may be helpful to crews that will come to the location to treat or remove the tree/trees in the User Notes. Then Submit in the upper right corner.

No Russian Olive:

If you have searched through a grid square and did not find a Russian Olive it is important to mark that cell as No Russian Olive. This will communicate to the others in your area that you have been through this grid cell and didn't find anything. It will also help the treatment crews know that someone searched the grid square and did not find a Russian Olive.

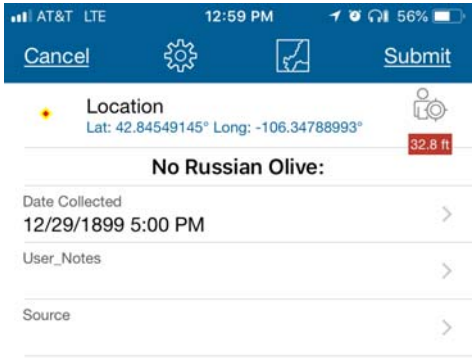
Russian olive was not found:

To mark a grid cell as observed with No Russian Olive present just touch the screen in the center of the grid square.

The pop-up shown above will appear. Select the box with an arrow (red arrow), then chose "collect here".

No Russian Olive (Continued):

Select "No Russian Olive", this is what you will see:



Select the "today" button under the date collected and submit.

Important Notes:

- Be safe! No information is worth anyone getting hurt over. If there are hazards in a grid square that prevent safe access just move to the next grid square and mark it as No Russian Olive and add user note stating "No safe access".
- Every grid square that you search gets either Russian Olives observations or the No Russian Olive observation so that we know all of the areas that were searched.
- Only make observations in the grid cells in your area. All of the Basemaps include grid squares from all of the areas for the full stretch of the river, and it is possible to make observations in any of the grid squares even if they aren't in your area. The way to tell what area you are in is by the last 2 or 3 letters in your map name. For example if you are collecting in the basemap WMA 1 Survey 2-WGF you will only make observations in grid cells that start with the WGF abbreviation.

Once every grid cell with your maps abbreviation has been searched and has an observation in it the area is complete, and you can move to your next area, if you have 2, or call Ethan @ 307-277-4344 to let me know you are done with your area. There is one additional area that early finishers can go to right at Cross Road Park if there is time.

APPENDIX C

2017 PROCEDURAL DOCUMENT

CITIZEN SCIENCE RUSSIAN OLIVE MONITORING

PROCEDURAL DOCUMENT

CITY OF CASPER

CASPER, WY

September 13, 2017

Project #: 13A-005-001

SUBMITTED BY: Trihydro Corporation

707 West 1st Street, Casper, WY 82601

PREPARED FOR: City of Casper

1200 North David Street, Casper, WY 82601

Table of Contents

1.0 INTRODUCTION

The Platte River Revival is a North Platte River restoration project that is considered to be in the top ten of river restoration projects in North America (http://www.casperwy.gov/residents/environment_and_waste). The project is driven by a decade of collaboration between private organizations and governmental agencies, and community support, through the annual Volunteer Day. The project has focused on management of Russian olive (*Elaeagnus angustifolia)* and rehabilitation of the North Platte River as it runs through the City of Casper (City). Much of the work involving Russian olive treatment and removal has been accomplished through volunteers and in-kind services. Recognizing the significant contributions of volunteers in the Platte River Revival's restoration efforts, the City formally established a community-driven data collection or "Citizen Science" program in 2017. This document outlines the purpose for collecting data, as well as the methods used to efficiently plan and effectively perform data collection events.

2.0 PURPOSE

Russian olive is a non-native tree that has become increasingly abundant in riparian areas throughout the western United States. It has been a target species for restoration projects along the North Platte River. Over the past century, Russian olive was widely planted throughout the United States as an ornamental and windbreak tree; however, it has since escaped into natural riparian areas where it frequently crowds out desirable native riparian trees such as cottonwood (*Populus spp*.) and willow (*Salix spp*.; USFS 2014). Because of its ability to colonize streambanks, Russian olive establishment and spread not only results in a loss of plant diversity, but can also cause changes in natural flooding regime and reduce the availability of soil nutrients and water (USFS 2014). Thus, efforts to remove and/or reduce the abundance of Russian olive trees from within riparian areas can lead to increased native species diversity and a gradual return of the area to the natural riparian ecosystem characteristics for the area, including wildlife habitat, hydrology, soil nutrient composition, and sequestration of runoff.

In 2016, the City determined that a monitoring program for evaluating Russian olive treatment results and a geodatabase to record monitoring data were an essential component of the Platte River Revival project. The geodatabase could be used to identify trends in treatment efficacy, target previously treated areas for follow-up actions, and provide the long-term data needed to track treatment areas and restoration progress. The City identified 19 Weed Management Areas (WMAs) in which Russian olive had been treated during the last 10 years or was targeted for treatment in the future. The data collected from within these areas was incorporated into a geodatabase, which will continue to be populated in the future as new monitoring data are collected and treatment efforts are performed. Citizen Science provides the public with an opportunity to actively learn about riparian habitat restoration and contribute to data collection efforts which are integral to the Platte River Revival's habitat restoration goals. The data collected through Citizen Science will ultimately be used by City staff and professional, contracted laborers, to plan, implement, and monitor treatments to reduce the presence of Russian olive along the Platte River.

3.0 MONITORING APPROACH

3.1 STRATEGIC PLANNING

The City has identified and mapped a total of 19 WMAs that have either been treated for Russian olive in the past decade or are targeted for treatment in the future. For the purpose of the Citizen Science Monitoring Program (Program), a grid has been overlaid upon each WMA, thus dividing it into subsections with unique identification codes. Subsections are a standard size, and consist of approximately 100 square yards. The larger the WMA, the more subsections it contains. The number of subsections within WMAs range between 20 and 364, so anticipating the number of volunteers necessary to efficiently survey an area is a critical step in the strategic planning phase. Assigning individuals or groups to specific subsections will ensure that data is collected throughout the entire WMA. The number of volunteers available to collect data and the number of subsections that must be surveyed will dictate the number of subsections assigned to each individual or group. As such, the use of subsections allow for flexible planning, as the number of volunteers may fluctuate annually. To increase efficiency of data collection and reduce confusion in the field, individuals or groups should be assigned a continuous series of adjoining subsections. Each subsection will be surveyed for to determine the presence or absence of Russian olive. The volunteer(s) will survey each subsection, and attach highly visible flagging tape to each Russian olive tree or stand of trees identified within the subsections. City staff, equipped with tablets, will follow the volunteers to record the presence or absence of Russian olive trees, and record details concerning the extent of the invasive establishment. Details recorded at each observation point are described in Section 3.2. Once the flagged tree(s) have been recorded by City staff, the volunteer(s) will attach a second series of flagging tape of a distinctly different color to the tree(s), to indicate which areas have been recorded. The second series of flagging ensures that no areas are subject to recounting errors. After surveying and recording is complete, trees should exhibit two, distinct flagging colors; one color indicates the tree was identified by volunteers, the other indicates that the tree was recorded by City staff.

3.2 USING THE COLLECTOR APPLICATION

The Collector Application for ArcGIS (Application) is the software that will be used to record data. A Systematic User Guide has been developed to guide volunteers in the data collection process. A copy of the Systematic User Guide is included as Appendix A. The Application is a user-friendly tool designed for smartphones and tablets that allows users to collect field data in the form of point, line, and polygon features (e.g. objects, routes, areas, etc.). The Application can be customized, by uploading maps that have been developed by the user. Additionally, the Application can be structured, so that users are only able to collect the most pertinent data. The ability to provide users with a customized, streamlined format reduces

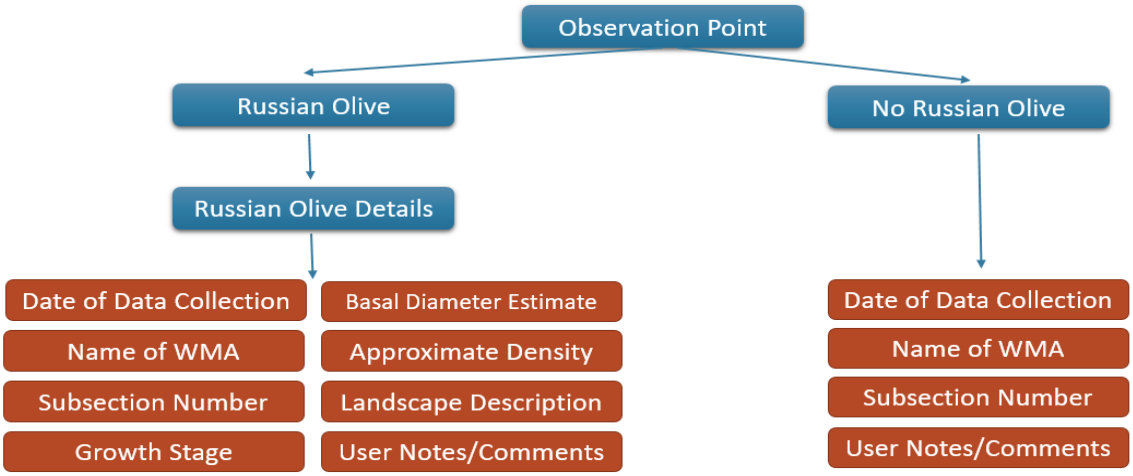
user error, as access to the Application's full range of capabilities may confuse users who are less familiar with the Program or the Application. The customizable nature of the Application ensures that all data necessary to reach Program goals are collected, while limiting user error.

Within each subsection, volunteers will determine if Russian olive is either present or absent, and record that information via observation point(s) using the Collector Application. This approach maximizes the likelihood that data are recorded for all subsections. In the case of subsections in which there are no Russian olive trees present, a single observation will be collected within the center of the WMA to record this observation. WMAs with Russian olive trees will range in the number of observations, depending upon the number of trees and stands of trees present. The largest WMA contains 364 subsections, but only a fraction of the subsections are likely to contain Russian olive. The details recorded in each observation point are detailed in Section 3.3.

3.3 COLLECTING OBSERVATION POINTS

The Collector Application data collection components and process are shown in the figure below. The schematic available in Figure 1 identifies the details recorded for each type of observation point.

Figure 1.



4.0 CHOOSING A RESPONSE

To ensure that each observation point is recorded accurately, the following responses should be used.

Date Collected:
The date of the observation will be recorded in the format of DD/MM/YYYY.

Weed Management Area (WMA):
The number of the WMA (1-19). The WMA fields will also indicate their treatment history (i.e. Treated, Untreated). Users will select a WMA from a dropdown list.

Weed Management Area (WMA) Subsection Number:
The unique code assigned to the subsection of a particular WMA. Subsection codes typically consist of the first letter of each word in the name of the WMA, followed by a numeric value that distinguishes each subsection within the WMA. The map provided on the Application includes codes for each subsection within the WMAs, and users will type this code into the subsection field.

Growth Stage:
The general growth stage of the Russian olive tree and/or stand of trees that is encountered (Immature, Mature). Immature is considered a thin, pliable tree that can be bent by hand. Conversely, mature trees are older and therefore more developed, rigid, trees that cannot be easily bent by hand. Identifying growth stage is important because the information will assist the City with determining the treatment approach. Immature trees can likely be pulled by hand or through minimal mechanical effort (i.e. shovel). Conversely, mature trees likely require mechanical treatment to be removed (i.e. backhoe, chainsaw, etc.). Users will select from a growth stage from a dropdown list.

Basal Diameter Estimate:
A visual estimate of the diameter of the tree trunk or trunks. The thick, thorny properties of Russian olive may make it difficult to access the trunk to conduct an exact basal measurement. As such, an estimate of the diameter of the tree trunk(s) should be recorded to the nearest foot. For the purpose of data collection and developing treatment approaches, several trees that are located in close proximity (i.e. within approximately 30 feet [10 yards]) to one another are considered a stand, and the basal diameter individual trunks within the stand should be estimated and

summed to a total approximate basal diameter. Estimated basal diameter will be recorded numerically. Estimated basal diameter will be recorded numerically.

Approximate Density:
The approximate density of trees is recorded as either a "single tree" or a "stand" of trees. If an observation point records a basal diameter for more than one tree, then it is a stand of trees. Users will select an approximate density from a dropdown list.

Landscape Description:
This field is not required but should be used to describe landscape characteristics that may be useful for treatment planning. Examples of important landscape descriptions include established trails, roads, (un)natural disturbances, or other observations that may be useful during treatment planning. For instance, roads within a WMA would facilitate access of heavy equipment. Users will describe any landscapes via text, which is limited to 200 characters.

User Notes/Comments:
This field is not required but should be used for any additional observations or comments. These remarks include but are not limited to the following: additional WMA descriptions, if the Russian olive observed appears to have been herbicide treated, recommendations for improving the application, recommendations for improving the monitoring approach, etc. Users will include any comments via text, which is limited to 200 characters.

5.0 QUALITY ASSURANCE/ QUALITY CONTROL

A key component of the Citizen Science Program is evaluating the accuracy of the data collected and identifying ways to improve the data collection process (as needed). A Quality Assurance and Quality Control (QA/QC) process will be completed after data have been collected during the annual Volunteer Day. This process will include two phases. The first phase will include independent field data collection by a professional biologist, who will use the monitoring approach and Collector Application software to survey a subset of the subsections assessed during Volunteer Day. The second phase of the QA/QC process includes the statistical comparison of the data collected by volunteers and the data collected by a professional biologist. The datasets will be analyzed through an assessment that focuses on similarity of results. This assessment will quantitatively determine the accuracy and repeatability of the Russian olive monitoring process. The results of the QA/QC process will help refine the Collector Application software and the monitoring approach, if necessary. Additionally, feedback recorded in the User Notes/Comments will be considered in the event that amendments to the Collector Application or monitoring approach are necessary.

6.0 LOOKING FORWARD

The City plans to continue providing the public with opportunities to engage in Citizen Science projects, such as the Platte River Revival, in an effort to cultivate a communal sense of pride while collecting pertinent data. The credibility of the data collected during these efforts, as well as post-survey comments concerning the monitoring approach, will refine and improve the process to ensure that the data collected through Citizen Science offers the utmost utility regarding future Platte River Revival events offered by the City. The scope of future Citizen Science monitoring campaigns may be expanded to collect data necessary to improve natural and developed areas within the City.

7.0 REFERENCES

United States Forest Service (USFS). 2014. Field Guide for Managing Russian Olive in the Southwest. United States Department of Agriculture. Available from: https://www.fs.usda.gov/Internet/FSE_DOCUMENTS/stelprdb5410126.pdf