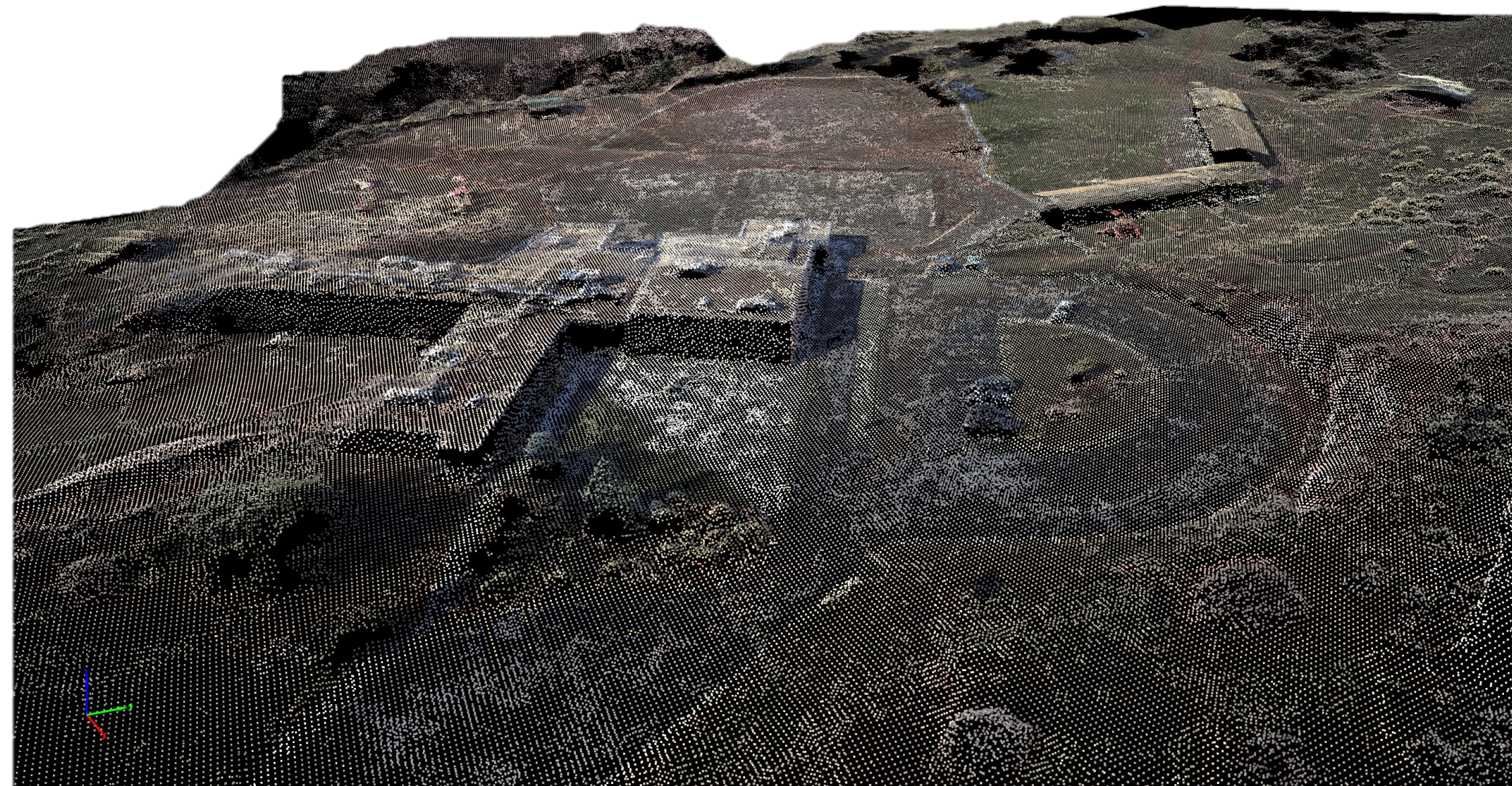


# Creating a 3D model of the town of Morrison, Colorado from unmanned aircraft system (UAS) data – preliminary results

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## Introduction

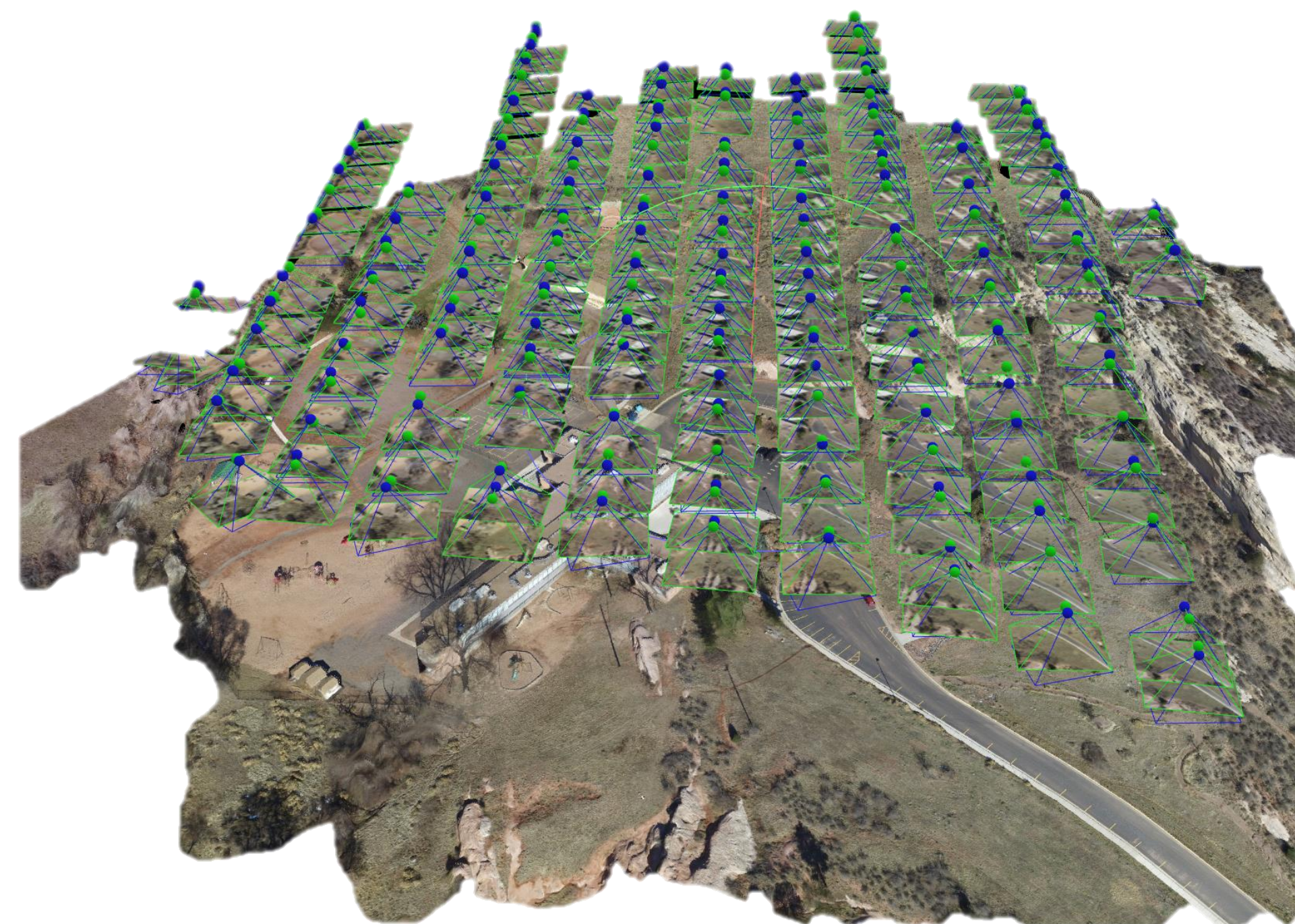
The United Nations estimates that 55% of the world's populations currently live in urbanized areas and this is expected to increase, at a point where in 2050 it is estimated that 68% of the population will live in urbanized areas. Northern America has approximately 82% of its population living in urbanized areas. With rapidly expanding populations come pressure on economic, political and social resources. Inciting the rapid need for the creation of jobs, infrastructure, health and safety resources and other socio-economic needs. Without proper planning the rapid, unmonitored, and unregulated growth of cities can lead to slums, limited resources and limits to effective and sustainable growth. With an ever-increasing global population comes increasing pressure to maintain the original feel of a city or town without compromising the quality of life of the residents. My research aims to use UAVs to create a 3D model of Morrison to create an effective tool to assist in town planning.



Point cloud, need to be edited in processing if insufficient data is captured

## Research Objectives

1. What are the processes involved with creating a realistic but cost-effective 3D model of the Town of Morrison?
  - What software and equipment are needed?
  - What would the ongoing costs and skills be needed to keep the system running?
2. What are the potential applications of the model for the Town of Morrison?
  - How can this project benefit the long-term future of Morrison and will it create a long-lasting impact for the residents?
  - How will the data be displayed so that it can be readily accessed?



Flight path and camera positions of the UAV

## Preliminary Results

A small section of Morrison (the local elementary school) was used to test the proposed methods. Outputs of running the images taken are shown in the below images. From the results there have been proposed alternations to the methods. This includes the use of ground control points to increase the precision of the model's placement in the real world, the inclusion of oblique images to complement the vertical images, to increase the model accuracy.

A meeting with Morrison council will be held in the near future, these preliminary results will be used to update the interested parties on the progress of the project. Furthermore, a basic flood model and use of the model to display proposed new buildings have been created (not shown on poster). These applications allow for a visual aid to the issues that Morrison may encounter rather than a written report or other methods.



3D Model of the Elementary School, located in Morrison, Colorado

## Background Information and Study Site

Morrison is located 16 miles from the city of Denver and has a total area of 5.68 km<sup>2</sup>. There are only 136 households within the governing area and of the residential buildings, a significant population of residents are in the local nursing home (Bear Creek Nursing Home). The town is a home rule municipality, self-governing and therefore has much autonomy into its future and current planning. It has a population of ~395, with a large percentage of the population being over the age of 60. With a small population, its revenue from tax is low. Thus, creating a process in which a model can be created, updated and utilized must not come with a large maintenance or initial cost. With these issues, a cost-effective method will be chosen to create the model such that the town can maintain it in the future. The project will focus on two main research questions. The first focusing on the creation of the model, while the second will be focusing on the applications of the model for future and current uses.

## Materials and Methods

An Inspire 4 and Phantom 4 pro UAV are being used for data collection. Morrison will be sectioned into different flight areas. A series of 4-6 weekends in Spring 2019 will be used to collect the data. The UAV will be flown as per ASPRS and FAA guidelines. The model is not expected to be used as a replacement for cadastral surveying quality work and therefore high resolution images were not taken. Once the images are taken they are processed through Pix4D Desktop. After the model has been created it will be run through post-processing software such as MODO and MeshLab to smooth out areas that may not have had enough data to create an acceptable surface. Once the model is created it will be added to a database with GIS data (flood models, road datasets, land use, etc.) where it will be applied to various situations that Morrison might encounter to test the usability of the model. This data will be compiled in ESRI ArcGIS Hub to create a webGIS that anyone can access.

## Conclusions and Acknowledgments

The project will create a 3D Model for the town of Morrison. From there it will host the data created and compiled on a webGIS hosted through the ESRI software which Morrison has a current license to. This will enable residents to access the data at will rather than have the data in an inaccessible place. My project aims to create these deliverables such that the Town of Morrison feels that I have benefitted them, rather than create a model that will not be used in the future. Finally, it is hoped that the workflow identified can be used for other towns that want to emulate what Morrison has done so that they can aid in planning their sustainable futures.

I would like to thank Morrison for allowing me to conduct research in their town. Professor Paul Sutton for being my thesis advisor. Steven Hick and Jedidiah Winter for providing all technical support (including flying the UAV).