8-2015

Maximizing Yield Using D.O.E in the (CIT) Giving Garden

Dennis Otremba
St. Cloud State University

This starred paper submitted by Dennis Otremba in partial fulfillment of the requirements for the Degree of Master of Engineering Management at St. Cloud State University is hereby approved by the final evaluation committee.

Ben Baliga
Chairperson

Hiral Shah

Kumanian

Marilyn Hart
Dean
School of Graduate Studies

MAXIMIZING YIELD USING D.O.E. IN THE (CIT) GIVING GARDEN

by

Dennis Otremba

B.S., Minnesota State University, Mankato, 2001

A Starred Paper

Submitted to the Graduate Faculty

of

St. Cloud State University

in Partial Fulfillment of the Requirements

for the Degree

Master of Engineering Management

St. Cloud, Minnesota

August, 2015

ABSTRACT

One of Cummins' six core values as stated by the management team is called "corporate responsibility". Part of that value includes the statements "Serve and improve the communities in which we live. Support company-sponsored community projects" (see Appendix E). Every Cummins employee is encouraged to support the core values. In addition, each Cummins employee is granted four EECC (Every Employee, Every Community) hours per calendar year to use towards community involvement programs.

ACKNOWLEDGEMENTS

I would like to acknowledge a few individuals who helped or supported my journey through the MEM program. I would like to thank Dr. Baliga for coordinating and leading the entire MEM program staff from SCSU and Metro State. I would also like to thank all of the instructors who gave up their Fridays and Saturdays during the last year and a half.

Next I would also like to thank the entire cohort #8 for not ever giving up. Without this diverse and knowledgeable group of people it would have been impossible to complete some of the projects we worked on together.

I cannot forget to thank my previous manager for supporting (and signing off on) my continuing education. Daniel Norrick pushed me every year to go to the next level of education. Dan (now retired) helped me pave the way for Cummins technicians to take on management roles.

I also have to thank Jacob Kreisel. He graduated from cohort #7 of the MEM program. Without Jacob's help and encouragement I may have given up. Now Jake and I work together in our new roles to improve Cummins Laboratory Operations at the ground level.

Lastly I must thank my spouse David for constantly pushing me into higher education and supporting my efforts along the way. With my every complaint he was

there to remind me that "You should have done this 10 years ago, you would have been done by now". Thank you for that, David.

TABLE OF CONTENTS

LIST OF TABLES

LIST OF FIGURES

INTRODUCTION

A charter to construct an onsite garden was authored by the project manager (Appendix B). It was submitted to the project sponsor for approval. Once approved a brief project scope was written to further clarify the project. It is as follows:

From a list of Cummins corporate charity partners one was chosen to receive the donated vegetables. The choice was based on need, location, and flexibility of delivery times.

A cost analysis was done to compare the different methods of container gardening. Before the garden was constructed it was decided whether to use containers (made from wood) or straw bales to contain the plant-growing media.

Once the type of garden was decided a team of volunteers were assembled. The volunteers were further categorized into garden builders, planters, maintainers, and harvesters.

Before the volunteers were put to work planting, a garden layout needed to be decided. The layout was determined by geographic location, size, watering method, and even plant choices.

The choice of the variety of plants to be planted was determined by geographic location, growing media, plant yield, and consumer choice. The layout of the plants

was determined by several factors including, but not limited to, ease of planting, space, plant-to-plant compatibility, and aesthetics.

Once all the aforementioned choices were made, the garden materials were ordered and delivered. A crew was assigned to build the garden. Garden construction had to be completed before the first planting day.

The garden was planted on two separate days. The first day was about 2 weeks before average last frost in MN. This day was reserved for all the plants that may be started from seed. The second planting day was after the average last frost day in MN. This day was reserved for plants that were delivered as seedlings.

Once the garden was constructed and planted a detailed schedule of maintenance and harvesting was created. Watering of the garden was done with automatic timer using a to be determined method.

The volunteers are responsible for harvesting the garden then delivering the fresh produce to the chosen charities.

PROBLEM STATEMENT

There is a constant need for food (especially fresh produce) in every community. Those in need maybe can't afford nutritious meals, do not have access to food shelves, or do not have the transportation opportunities. The garden provides some relief to as many people as possible. Recipients of the produce includes a homeless shelter for single women and their children and an assisted living facility for elderly adults who are still capable of cooking their own meals.

This garden also gives volunteers an opportunity to get away from their desks and workspaces to get some fresh air and exercise in the garden. The garden is also a place of education. Volunteers learn how to prepare, plant, maintain, fertilize, water, weed, and harvest a vegetable garden.

OBJECTIVE

This project created a healthy learning environment for the volunteers, a sense of satisfaction that comes from giving back to the community, and created relationships across business lines and functions. The project provides fresh produce to those in the community that are in need who wouldn't otherwise have access.

LITERATURE REVIEW

This project followed the methodology learned in Project Management class. The main phases of any large-scale project are Initiation, Planning, Execution, Control and Closing as illustrated below:

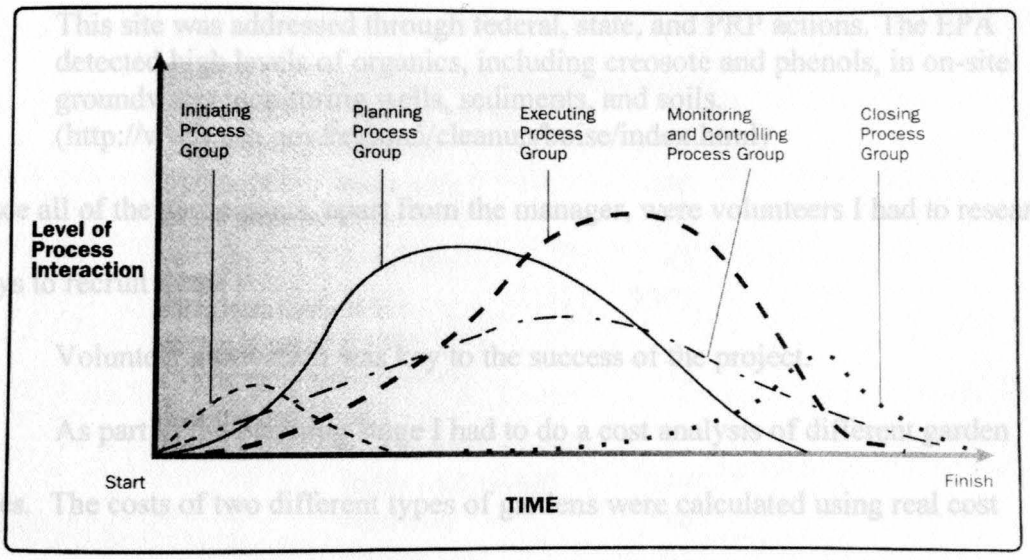


Figure 1: Main Phases of Large-Scale Projects (PML, 2013, p. 51)

The majority of the work was done in the Planning stage. "Individuals who think planning is unnecessary or a waste of time invariably need to find time later on to redo things" (Gido, Clements, 2012, p. 11). This is a very agreeable statement. Without proper planning, one of the three project trinities (author's word) are going to slip: schedule, budget, or resources. These three things have to remain in balance. For example, in order to shorten the schedule the budget and resources have to increase. Or if a project loses resources (people change roles, retire, etc.) the schedule will likely have to increase.

Before any groundbreaking could occur, research was done on the soil conditions because of past experiences with contamination on the property. It turned out that Cummins Power Generation is located on a federal superfund site. From the EPA website:

> This site was addressed through federal, state, and PRP actions. The EPA detected high levels of organics, including creosote and phenols, in on-site groundwater monitoring wells, sediments, and soils. (http://www.epa.gov/region5/cleanup/boise/index.html)

Since all of the participants, apart from the manager, were volunteers I had to research ways to recruit them.

Volunteer motivation was key to the success of the project.

As part of the planning stage I had to do a cost analysis of different garden types. The costs of two different types of gardens were calculated using real cost numbers if materials were purchased from Menards. See Appendix D for more information on the Environmental Protection Agency's findings.

Obviously after obtaining the above information it was imperative that the garden be constructed in some sort of "raised" design. Planting vegetables in contaminated soil was not an option.

Option one was a raised garden built with 2x12 boards that are 12 feet long. This garden would be assembled with deck screws and filled with topsoil. The soil would be amended with fertilizer each year. The dirt cost was for 27 yards at $30 per yard, delivered.

Option two was a straw bale garden. The cost was calculated by using locally sourced bales. The cost was $5.50 per bale, delivered. The bales also needed to be amended with fertilizer at a rate twice that of the soil garden (author's experience, no citation needed). With this garden there is also a cost of potting soil. The following table shows the breakdown of costs associated with each option:

Table 1: Breakdown of Costs

Raised garden	
Lumber	1120
Fasteners	400
Dirt	810
Fertilizer	42
Total	**2372**
Yearly cost (fertilizer)	42
Straw bale garden	
Bales (delivered)	550
Fertilizer	84
Potting soil	64
Total	**698**

To compare the two options, a table was set up for a mutually exclusive project calculation:

Table 2: Project Scope Document

			Incremental	
Year	Raised	Straw	Raised	Straw
0	-2372	-698	-2372	-698
1	-42	-698	-2414	-1396
2	-42	-698	-2456	-2094
3	-42	-698	-2498	-2792
4	-42	-698		
5	-42	-698		
6	-42	-698		
7	-42	-698		
8	-42	-698		
9	-42	-698		
10	-42	-698		
Present Worth	-$2,630.07	-$7,678.00		
EAC	$428.03	$1,249.56		

The lifespan of the raised garden was estimated to be ten years based with the use of untreated lumber. A straw bale garden will only last one year as the bales decompose throughout the season (Karsten, 2011, p. 31). Therefore all the bales, fertilizer, and potting soil need to be repurchased each year.

From the calculations above you can see that the raised garden has a higher initial cost but the "payback" overcomes the straw bale garden in about 3 years. You can also see that the present worth of the raised garden is less negative. By including the Equivalent Annual Cost calculation, it is shown to be about a third of the annual cost of the straw bale garden. Normally, one would choose the raised garden because of this alone (Eschenbach, 2011, p. 229). However, initial funding that the raised garden required could not be secured. Also, the straw bale garden was less of a commitment of space as it can be moved next year if it is a success and approved again.

This project was going to require a lot of supplies. The supplies could only be sourced once the type of garden was decided. Once it was known that the garden was going to be built out of straw bales that there were two choices: source the bales near the city at a high bale cost with low transportation cost or, source the bales from further away and pay more in transportation costs. This is a basic supply chain fact.

METHODOLOGY

The most important part of a project of any size is the planning stage. After creating the project scope document (above) a work breakdown structure (WBS) was

created. A "WBS is the process of subdividing project deliverables into smaller, more manageable components. The key benefit of this process is that it provides a structured vision of what has to be delivered" (PML, 2013, p. 125).

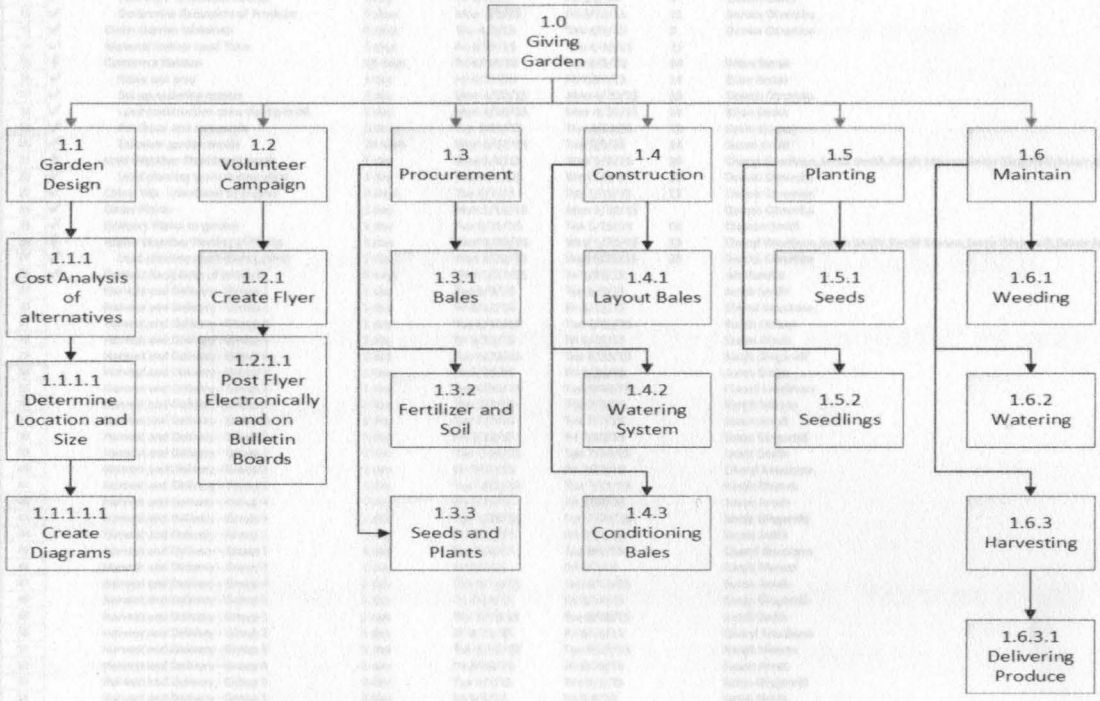


Figure 2: Work Breakdown Structure

The WBS above is organized by project phase. This is somewhat of a linear project meaning each phase is mostly dependent on the previous phase's completion. The resources may or may not be assigned at this point. They were assigned when creating the following project timeline:

Giving Garden Timeline

ID		Task Name	Duration	Start	Finish	Predecesso	Resource Names
0		**Giving Garden Timeline**	**181 days?**	**Mon 2/16/15**	**Fri 10/23/15**		
1		**Determine Garden Type**	**5 days**	**Mon 2/16/15**	**Fri 2/20/15**		**Dennis Otremba**
2	✓	Analysis of cost	2 days	Mon 2/16/15	Tue 2/17/15		Dennis Otremba
3	✓	Determine location	3 days	Wed 2/18/15	Fri 2/20/15	2	Dennis Otremba
4		**Determine Plant Count**	**5 days**	**Mon 2/23/15**	**Fri 2/27/15**	**3**	**Dennis Otremba**
5	✓	Determine Garden Size	1 day	Mon 2/23/15	Mon 2/23/15	3	Dennis Otremba
6	✓	Create Garden Diagram	4 days	Tue 2/24/15	Fri 2/27/15	5	Dennis Otremba
7	✓	Start Seeds indoors if applicable	59 days	Sat 2/28/15	Wed 5/20/15	6	Susan Arndt
8		**Volunteer Campaign**	**24 days**	**Sat 2/28/15**	**Wed 4/1/15**	**6**	**Dennis Otremba,Elena Dooley**
9	✓	Create Flyer	4 days	Mon 3/2/15	Thu 3/5/15		Dennis Otremba
10	✓	Post Flyer to electronic billboards	1 day	Fri 3/6/15	Fri 3/6/15	9	Elena Dooley
11	✓	Post Flyer to bulletin boards	1 day	Fri 3/6/15	Fri 3/6/15	9	Elena Dooley
12	✓	Determine Recipiants of Produce	5 days	Mon 3/9/15	Fri 3/13/15	11	Dennis Otremba
13	✓	Order Garden Materials	6 days	Thu 4/2/15	Thu 4/9/15	8	Dennis Otremba
14	✓	Material Deliver Lead Time	5 days	Fri 4/10/15	Thu 4/16/15	13	
15		**Construct Garden**	**13 days**	**Fri 4/17/15**	**Tue 5/5/15**	**14**	**Brian Bozak**
16	✓	Stake out area	1 day	Fri 4/17/15	Fri 4/17/15	14	Brian Bozak
17	✓	Set up watering system	1 day	Mon 4/20/15	Mon 4/20/15	16	Dennis Otremba
18	✓	Lead construction crew during build	1 day	Mon 4/20/15	Mon 4/20/15	16	Brian Bozak
19	✓	Purchase and sort seeds	3 days	Tue 4/21/15	Thu 4/23/15	18	Kevin Keene
20	✓	Enhance garden media	10 days	Wed 4/22/15	Tue 5/5/15	18	Susan Arndt
21		**Cold Weather Planting of seeds**	**1 day**	**Wed 5/6/15**	**Wed 5/6/15**	**20**	**Cheryl Knudtson,Jacob Smith,Ranjit Menon,Sonja Gingerelli,Susan Ar**
22	✓	Lead planting team during plant	1 day	Wed 5/6/15	Wed 5/6/15	20	Dennis Otremba
23	✓	China Trip - Unrelated to project	9 days	Thu 5/7/15	Tue 5/19/15	22	Dennis Otremba
24	✓	Order Plants	1 day	Mon 5/18/15	Mon 5/18/15		Dennis Otremba
25	✓	Delivery Plants to garden	1 day	Tue 5/19/15	Tue 5/19/15	24	Clayton Smith
26		**Warm Weather Planing of Plants**	**1 day**	**Wed 5/20/15**	**Wed 5/20/15**	**23**	**Cheryl Knudtson,Jacob Smith,Ranjit Menon,Sonja Gingerelli,Susan Ar**
27	✓	Lead planting team during plant	1 day	Wed 5/20/15	Wed 5/20/15	23	Dennis Otremba
28	✓	Contact Recipiants of produce	3 days	Wed 5/27/15	Fri 5/29/15		Art Punyko
29		Harvest and Delivery - Group 1	1 day	Tue 6/9/15	Tue 6/9/15		Jacob Smith
30		Harvest and Delivery - Group 2	1 day	Fri 6/12/15	Fri 6/12/15		Cheryl Knudtson
31		Harvest and Delivery - Group 3	1 day	Tue 6/16/15	Tue 6/16/15		Ranjit Menon
32		Harvest and Delivery - Group 4	1 day	Fri 6/19/15	Fri 6/19/15		Susan Arndt
33		Harvest and Delivery - Group 5	1 day	Tue 6/23/15	Tue 6/23/15		Sonja Gingerelli
34		Harvest and Delivery - Group 1	1 day	Fri 6/26/15	Fri 6/26/15		Jacob Smith
35		Harvest and Delivery - Group 2	1 day	Tue 6/30/15	Tue 6/30/15		Cheryl Knudtson
36		Harvest and Delivery - Group 3	1 day	Thu 7/2/15	Thu 7/2/15		Ranjit Menon
37		Harvest and Delivery - Group 4	1 day	Tue 7/7/15	Tue 7/7/15		Susan Arndt
38		Harvest and Delivery - Group 5	1 day	Fri 7/10/15	Fri 7/10/15		Sonja Gingerelli
39		Harvest and Delivery - Group 1	1 day	Tue 7/14/15	Tue 7/14/15		Jacob Smith
40		Harvest and Delivery - Group 2	1 day	Fri 7/17/15	Fri 7/17/15		Cheryl Knudtson
41		Harvest and Delivery - Group 3	1 day	Tue 7/21/15	Tue 7/21/15		Ranjit Menon
42		Harvest and Delivery - Group 4	1 day	Fri 7/24/15	Fri 7/24/15		Susan Arndt
43		Harvest and Delivery - Group 5	1 day	Tue 7/28/15	Tue 7/28/15		Sonja Gingerelli
44		Harvest and Delivery - Group 1	1 day	Fri 7/31/15	Fri 7/31/15		Jacob Smith
45		Harvest and Delivery - Group 2	1 day	Tue 8/4/15	Tue 8/4/15		Cheryl Knudtson
46		Harvest and Delivery - Group 3	1 day	Fri 8/7/15	Fri 8/7/15		Ranjit Menon
47		Harvest and Delivery - Group 4	1 day	Tue 8/11/15	Tue 8/11/15		Susan Arndt
48		Harvest and Delivery - Group 5	1 day	Fri 8/14/15	Fri 8/14/15		Sonja Gingerelli
49		Harvest and Delivery - Group 1	1 day	Tue 8/18/15	Tue 8/18/15		Jacob Smith
50		Harvest and Delivery - Group 2	1 day	Fri 8/21/15	Fri 8/21/15		Cheryl Knudtson
51		Harvest and Delivery - Group 3	1 day	Tue 8/25/15	Tue 8/25/15		Ranjit Menon
52		Harvest and Delivery - Group 4	1 day	Fri 8/28/15	Fri 8/28/15		Susan Arndt
53		Harvest and Delivery - Group 5	1 day	Tue 9/1/15	Tue 9/1/15		Sonja Gingerelli
54		Harvest and Delivery - Group 1	1 day	Fri 9/4/15	Fri 9/4/15		Jacob Smith
55		Harvest and Delivery - Group 2	1 day	Tue 9/8/15	Tue 9/8/15		Cheryl Knudtson
56		Harvest and Delivery - Group 3	1 day	Fri 9/11/15	Fri 9/11/15		Ranjit Menon
57		Harvest and Delivery - Group 4	1 day	Tue 9/15/15	Tue 9/15/15		Susan Arndt
58		Harvest and Delivery - Group 5	1 day	Fri 9/18/15	Fri 9/18/15		Sonja Gingerelli
59		Harvest and Delivery - Group 1	1 day	Tue 9/22/15	Tue 9/22/15		Jacob Smith
60		Harvest and Delivery - Group 2	1 day	Fri 9/25/15	Fri 9/25/15		Cheryl Knudtson
61		Harvest and Delivery - Group 3	1 day	Tue 9/29/15	Tue 9/29/15		Ranjit Menon
62		Harvest and Delivery - Group 4	1 day	Fri 10/2/15	Fri 10/2/15		Susan Arndt
63		Harvest and Delivery - Group 5	1 day	Tue 10/6/15	Tue 10/6/15		Sonja Gingerelli
64		Harvest and Delivery - Group 1	1 day	Fri 10/9/15	Fri 10/9/15		Jacob Smith
65		Harvest and Delivery - Group 2	1 day	Tue 10/13/15	Tue 10/13/15		Cheryl Knudtson
66		Harvest and Delivery - Group 3	1 day	Fri 10/16/15	Fri 10/16/15		Ranjit Menon
67		Harvest and Delivery - Group 4	1 day	Tue 10/20/15	Tue 10/20/15		Susan Arndt
68		Harvest and Delivery - Group 5	1 day	Fri 10/23/15	Fri 10/23/15		Sonja Gingerelli
69							

Figure 3: Timeline

The above timeline produced the following Gantt chart:

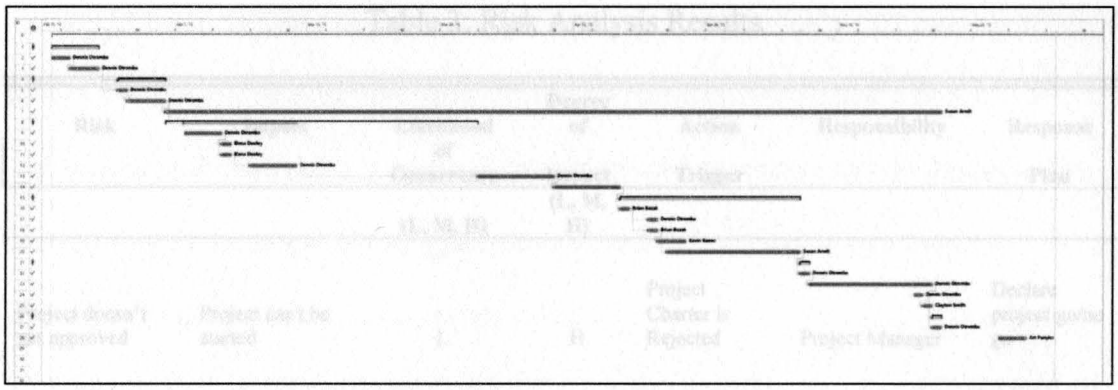


Figure 4: Gantt Chart

The Gantt chart provides a visual indication of which tasks can be done in parallel and which ones can be done in series. For this project almost all of the tasks were in series meaning that they are almost all on the critical path.

Risk Analysis

A risk analysis was performed prior to starting the project. Below are results of the analysis:

Table 3: Risk Analysis Results

Risk	Impact	Likelihood of Occurrence (L, M, H)	Degree of Impact (L, M, H)	Action Trigger	Responsibility	Response Plan
Project doesn't get approved	Project can't be started	L	H	Project Charter is Rejected	Project Manager	Declare project go/no go
No suitable location can be found	Project can't be started	L	H	Permission denied by plant management	Project Manager	Declare project go/no go
Cost of materials too high	Project can't be started	M	H	Budget review comes back negative	Project Manager	Declare project go/no go
Too few volunteers are interested	Project timeline will slip and/or size of the garden will be reduced	L	M	Response from volunteer campaign analyzed	Project Manager	Reduce garden size
Frost happens after seedlings are planted	Some or all plants may die	L	H	Monitor weather for possible freeze after May 17th	Project Manager	Cover garden with sheets of plastic
Poor weather on garden construction day	Construction gets delayed	M	L	Monitor weather on the day before construction	Project Manager	Backup construction day were built into the calendar
Poor weather on planting day(s)	Planting gets delayed	M	M	Monitor weather on the days before planting	Project Manager	Backup planting days were built into the timeline
Catastrophic weather destroys garden	Project is cancelled or replanted with short-season plants	L	H	Tornado comes through	Project Manager	Cancel project or replant
Garden pests eat crops	Lower yield	M	M	Reports of damaged produce	Row Leaders	Natural pest repellents will be used

At this point the project needed volunteers. It was quickly realized that word of mouth was not going to be enough to recruit the number of volunteers needed. A flyer was posted both physically on the bulletin boards and electronically on the monitors located around the plant. The original design (seen below) had to be modified to fit the electronic system's format, also shown below.

Figure 5: Original Flyer

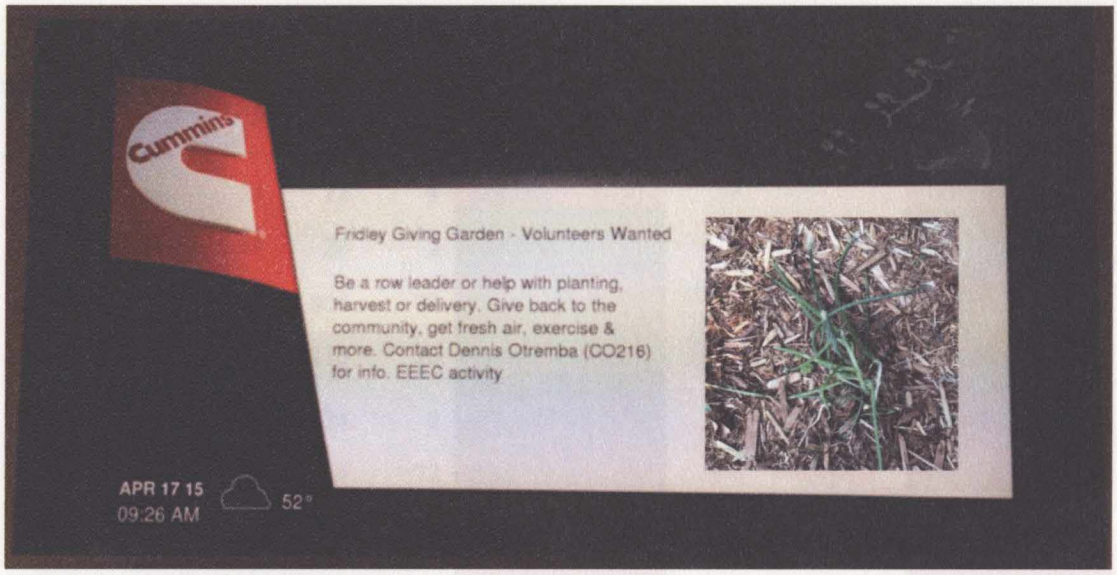


Figure 6: Flyer Modified for Electronic Display

The planning of the physical garden is outlined in the next pages. The following garden "map" was repeated six times for a total of 12 rows. This map also helped tally the total number of plants and seeds needed.

Table 4: Planning the Physical Garden

	Order total	Total	Per bale	NORTH (Building)		NORTH (Building)
Tomato plants	24	12	1	Tomato		Tomato
Pepper plants	48	24	2	2 Pepper		2 Pepper
Beet seeds	1728	864	72	Beet	Butternut Squash	Beet
Bean seeds	432	216	18	Bean		Bean
Zucchini plants	24	24	2	2 Zucchini		2 Zucchini
		864	72	Beet		Beet
Kohlrabi plants	72	72	6	6 Kohlrabi		6 Kohlrabi
Radish seeds	1728	864	72	Radish		Radish
Cucumber plants	48	24	2	2 Cucumber		2 Cucumber
		216	18	Bean		Bean
Carrot seeds	1728	864	72	Carrot	Acorn Squash	Carrot
		864	72	Radish		Radish
		24	2	2 Cucumber		2 Cucumber
		864	72	Carrot		Carrot
		24	2	2 Pepper		2 Pepper
		12	1	Tomato		Tomato
				SOUTH (Warehouse)		SOUTH (Warehouse)

Once the garden volunteers were identified the project manager assigned six volunteers as row leaders. Each row leader was responsible for two rows. The row leaders could then build a team to help them with the planting, weeding, and harvesting of their rows.

The following instructions were made for the planting days. Each row has the same order for simplicity since the volunteers likely have little experience in identifying plants once they start to grow.

Table 5: Instructions for Planting Days

	NORTH (Building)	
Bale 8	Tomato	Tomato: Plant deep enough to BURY first set of leaves
	2 Pepper	Pepper: Plant deep - UP TO first set of leaves
Bale 7	Beet	Beets: 6 rows, seeds spaced 1/2" apart
	Bean	Beans: 6 groups of 3 seeds each ("EYE" pointed DOWN)
Bale 6	2 Zucchini	Zucchini: 2 bunches of 3 plants each
	Beet	Beets: 6 rows, seeds spaced 1/2" apart
Bale 5	6 Kohlrabi	Kohlrabi: 6 groups of 3 seeds each
	Radish	Radishes: 6 rows, seeds spaced 1/2" apart
Bale 4	2 Cucumber	Cucumber: 2 bunches of 3 plants each
	Bean	Beans: 6 groups of 3 seeds each ("EYE" pointed DOWN)
Bale 3	Carrot	Carrots: 6 rows, seeds spaced 1/2" apart
	Radish	Radishes: 6 rows, seeds spaced 1/2" apart
Bale 2	2 Cucumber	Cucumber: 2 bunches of 3 plants each
	Carrot	Carrots: 6 rows, seeds spaced 1/2" apart
Bale 1	2 Pepper	Pepper: Plant deep - UP TO first set of leaves
	Tomato	Tomato: Plant deep enough to BURY first set of leaves
	SOUTH (Warehouse)	

The detailed bale diagrams that were used on the planting days are listed in Appendix F.

After the delivery of the straw bales and the actual construction of the garden, the bales needed to be "conditioned." The following amounts of fertilizer and schedule was followed:

Conditioning Schedule

Day 1: Sprinkle evenly ½ cup per bale Ammonium Nitrate (34-0-0) fertilizer. Then water aggressively until water runs out bottom

Day 2: Water

Day 3: Sprinkle ½ cup (34-0-0) evenly per bale + water.

Day 4: Water

Day 5: Sprinkle ½ cup (34-0-0) evenly per bale + water.

Day 6: Water

Days 7-9: Sprinkle ¼ cup (34-0-0) evenly per bale + water.

Day 10: Sprinkle 1 cup (10-10-10) evenly per bale + water.

Day 11 or 12: PLANTING!

Figure 7: Fertilizer and Schedule of Use

Straw Bale Conditioning

The conditioning of the bales does two things: 1) It provides food for the plants to grow as the straw has nearly zero nutritional value. 2) It starts the decomposition process which also produces heat. A little extra heat can allow you to plant earlier in

the season. In MN you can generally plant seeds or frost-hearty plants in late April. Plants that are sensitive to frost must be planted after the average last frost date of May 17th (Karsten, 2011, p. 5).

Everything up to this point had been right on schedule. Then came the first planting day. There was a great volunteer turnout (16 people). However, there were closer to 30 volunteers who said they would help out. This meant that the project manager had to stay an extra hour to finish up planting the last couple rows. What a difference it makes having more hands to help!

Once the seeds were in the ground the watering system was turned on. It consisted of four impact sprinklers with one at each corner of the garden. Since the water supply could not provide enough pressure to run all four at the same time, two electronic timers had to be used. One timer was set to start at 5 AM and run for 30 minutes while the other was set to start at 5:30 AM and run for 30 minutes.

Common gardener knowledge dictates that watering is done in the early morning hours for several reasons: At that time of day there is little to no sun and little to no wind, both of which increase evaporation which in turn decreases efficiency. Also, watering early in the morning allows the leaves of the plants to dry quicker, reducing the chances of damaging mold to form.

Time was built into the schedule for the project manager to be away in China on an educational tour. The plants were scheduled to be delivered the day before planting just in case delivery was delayed. They were simply left out near the garden

in their plastic trays. They were grown by a local farmer (Smith Farms of Maple Grove) whose son also works at Cummins and is an ally of the project manager.

Again, the volunteer turnout was far less than expected for the second planting day. Those that did show up did double the work, the project manager ended up staying late again as well. Another snag that was not anticipated in the risk analysis: 24 tomato plants were ordered but 48 plants were delivered. The extra plants were free and not worth the effort of returning them. It would have also been unethical for volunteers to take them home for their own gardens as the project is for charity. The project manager made the decision to double up the plants at the ends of the rows and hope for the best.

At this point in the project it is a matter of water and wait. This slack time allowed the project manager to contact the recipients of the produce and set up a schedule for deliveries.

There were two recipients chosen from the list of forty-plus community partners that Cummins is involved with. The first one is a place called People Serving People. It is a shelter located downtown Minneapolis near the new football stadium. They provide a place to live and food to eat for single mothers and their children. The author volunteers to serve food there a few times a year so he was familiar with the setup. They have a commercial kitchen but most of the food served there is heat-and-eat processed food. The reason being is that fresh produce is more costly to purchase and requires more resources to prepare it. Since the giving garden will only yield a

small amount of fresh produce it won't be a burden on the cooks. It will also be a surprise treat for clients they serve.

The second chosen community partner to receive the produce was Parkview Villa in Columbia Heights. Parkview is an assisted living facility for adults. Their clients have their own apartments with kitchens and cook for themselves. They also have limited available transportation options. For them, the fresh produce from the giving garden delivered on Fridays will be a supplement to their existing diets. The managers at the facility set up a sort of free "farmer's market" in the lobby for the people living there. Each resident is allowed to choose which vegetables they want.

RESULTS

The results of the project have not yet been fully realized as the growing season in MN can last into October. However, the following is a list of accomplishments to date:

- Project and funding approval by project sponsor
- Procurement and delivery of garden supplies:
  - Straw bales
  - Seeds and plants
  - Fertilizer
  - Potting soil
  - Watering system
  - Miscellaneous donated items

- Construction and bale conditioning
- Volunteer campaign
- Work breakdown and schedule planning
- Planting of the garden
- Harvesting has begun
- Deliveries have been made to both of the charities

It is expected that the garden will be harvested two times per week. The row leaders will rotate harvest days. They will also each be responsible for recruiting a team to help them with the harvest of the entire garden on those days. They will also be responsible for the delivery of the produce to People Serving People on Tuesdays and Parkview Villa on Fridays.

When the growing season is completed and all the produce is harvested there will be decomposed straw bales and dead plants to be disposed of. The plan is to have a team of volunteers clean it up. It will make excellent compost. If no other Cummins employee wants to take it for compost, an ad will be posted on Craigslist for "best offer." Any money made off of the compost material will be rolled into the annual United Way campaign that runs in October.

SUMMARY

The summary will serve as an informal section that includes some of my experiences and lessons learned from my first project manager role.

First of all one cannot stress enough how important it is to make a good plan before starting any project. As stated above, in this project almost every task landed on the critical path. That made the planning even more critical to success. Plans also had to made around the 8 days the project manager needed for the trip to Shanghai.

Delegation was also a very important element of this project. The work could have been done by one person but that would not have allowed for any time for that person's real job. The deliveries and construction were both delegated to volunteers. Some of the bale conditioning was delegated on weekends when the project manager was not available. Even some of the volunteer procurement was delegated to the row leaders–they had to find their own team members to help them on planting days and harvest/delivery days.

One very important lesson that was learned: not everything goes as planned. Even the simplest tasks can go awry (there's a big difference between 24 and 48 tomato plants!). Another lesson: volunteers are not reliable resources. In the future, one should "hire" double the volunteers needed knowing only half of them will actually show up.

The most important lesson learned? Giving back to the community in which you live feels really good. There are so many people out there that need help. This project was a LOT of work and took a LOT of free time but it was worth every effort. The project manager even set a new goal for this year: Get every one of the 14 people currently managed to use up every hour of their EEEC time. It won't be for his benefit. It may not even benefit them. It will, however, affect the lives of people in

need. That's worth more than any piece of equipment that rolls off of our assembly line.

REFERENCES

Environmental Protection Agency (EPA). (n.d.). *Boise Cascade/Onon/Medtronics superfund site*. Retrieved from http://www.epa.gov/region5/cleanup/boise/index.html.

Eschenbach, T. G. (2010). *Engineering economy: Applying theory to practice* (3rd ed). New York: Oxford University Press. (ISBN-13: 9780199772766; ISBN-10: 0199772762)

Gido, J., & Clements, J. P. (2012). *Successful project management* (6th ed.). Mason, OH: South-Western Cengage Learning.

Karsten, J. (2011). *Straw bale gardening*. Self Published.

Phadke, M. (1989). *Quality engineering using robust design*. New Jersey: Pearson Education.

PMI. (2013). *PMBOK guide*. Pennsylvania: Project Management Institute.

REFERENCES

Environmental Protection Agency (EPA). (n.d.). *Boise Cascade/Onan/Medtronics superfund site*. Retrieved from http://www.epa.gov/region5/cleanup/boise/index.html.

Eschenbach, T. G. (2010). *Engineering economy: Applying theory to practice* (3rd ed). New York: Oxford University Press. (ISBN-13: 9780199772766; ISBN-10: 0199772762)

Gido, J., & Clements, J. P. (2012). *Successful project management* (6th ed.). Mason, OH: South-Western Cengage Learning.

Karsten, J. (2011). *Straw bale gardening.* Self Published.

Phadke, M. (1989). *Quality engineering using robust design.* New Jersey: Pearson Education.

PMI. (2013). *PMBOK guide*. Pennsylvania: Project Management Institute.

APPENDICES

APPENDIX A

Design of Experiment–Radish

Design of Experiment–Radish

In an effort to improve yield for the fall planting of radishes, a Design of Experiment (DOE) using the method learned in the EM 560 Quality Engineering course was used.

There were four factors to look at. The amount of fertilizer seemed like lot. Fertilizer is also expensive. It was decided to start with the recommended amount and use the other two levels to reduce the amount. Seed spacing can have a huge impact of the size of the radish produced (author's own experience)–planted too close together the plant will not even produce a bulb, planted too far apart wastes garden space. The middle level was chosen as the standard. It was thought the variety of radish may make a difference in yield therefore three different ones were chosen. The water factor was basically a bonus (more on that later).

Here's a breakdown of the factors and their levels:

Factor	Level 1	Level 2	Level 3
Fertilizer	1 cup	1.5 cups	2.25 cups
Seed Spacing	1"	2"	3"
Variety	Cherry	Cherry Giant	Patricia
Water	1 quart	2 quarts	1 gallon

Fertilizer:	Level 3 is the recommended level (Karsten, 2011, p. 24)
Seed Spacing:	Level 2 in the recommended level (seed packet instructions)
Variety:	Cherry was the most popular on the retailer's shelf
Water:	Extra water is only applied on non-rain days

"The first step in constructing an orthogonal array to fit a specific case study is to count the total degrees of freedom that tells the minimum number of experiments that must be performed to study all the chosen control factors" (Phadke, 1989, p. 150). Therefore, the following formula was used:

Factor	Degrees of Freedom
Overall Mean	1
A, B, C	3 x (3 – 1) = 6
Total	1 + 6 = 7 experiments minimum

Using Table 7.1 (Phadke, 1989, p. 152) the best standard orthogonal array to use was an L_9 or 3^4. It had the minimum experiments of 7, the correct amount of levels, but one extra factor. Originally the author wanted to only study fertilizer amount, seed spacing and variety. But since this array allowed for one more factor, water was chosen as a 4th factor to fill out the table.

The resulting experiment table looked like this:

Experiment	Fertilizer	Seed Spacing	Variety	Water
1	1	1	1	1
2	1	2	2	2
3	1	3	3	3
4	2	1	2	3
5	2	2	3	1
6	2	3	1	2
7	3	1	3	2
8	3	2	1	3
9	3	3	2	1

There were six straw bales available for the experiment (9 bales were ordered but the supplier only delivered 6). The following diagram shows how those six bales were divided up into the nine different experiments:

Bales 1-6:	1		2		3		4		5		6	
Fertilizer:	1 – 1 cup				2 – 1.5 cups				3 – 2.25 cups			
Spacing:	1"	2"	3"		1"	2"	3"		1"	2"	3"	
Variety:	1 - Cherry	2 - Cherry Giant	3 - Patricia		2 - Cherry Giant	3 - Patricia	1 - Cherry		3 - Patricia	1 - Cherry	2 - Cherry Giant	
Water:	1 - 1 qt.	2 - 2 qts.	3 - 1 gal.		3 - 1 gal.	1 - 1 qt.	2 - 2 qts.		2 - 2 qts.	3 - 1 gal.	1 - 1 qt.	

The amount of fertilizer is measured per bale, therefore, that was the first factor used to divide up the bales. That division made application easier.

APPENDIX B

Project Charter

Project Charter (This is a copy of the original that was submitted)

Project Title: Community Involvement Team (CIT) Giving Garden

Purpose: One of Cummins' Core Values as stated by the management team is called Corporate Responsibility. Part of that value includes the statements "Serve and improve the communities in which we live. Support company-sponsored community projects." Every Cummins employee is encouraged to support the core values. In addition, each Cummins Employee is granted four EECC (Every Employee, Every Community) hours per calendar year to use towards community involvement programs.

Description: In cooperation with the Twin Cities Corporate Giving Garden Network, which is championed by Blue Cross and Blue Shield of Minnesota, a garden will be constructed on Cummins property at the Fridley campus. The garden will be built and maintained by Cummins employees. All produce generated by the garden will be donated to community partners in need.

Objective: This project will create a healthy learning environment for the volunteers; a sense of satisfaction that comes from giving back to the community; and likely will create relationships across business lines and functions. The project will also provide fresh produce to those in the community that are in need who wouldn't otherwise have access.

Success criteria or expected benefits: There is a constant need for food (especially fresh produce) in every community. Those in need maybe can't afford nutritious meals, don't have access to food shelves, or don't have the transportation

opportunities. The garden will provide some relief to as many people as possible. Recipients of the produce may include, but are not limited to, homeless shelters, assisted living facilities, and/or emergency shelters for adult women.

This garden will also give volunteers an opportunity to get away from their desks and workspaces to get some fresh air and exercise in the garden. The garden will also be a place of education. Volunteers will learn how to prepare, plant, maintain, fertilize, water, weed, and harvest a vegetable garden.

Funding: Funds will come from Cummins CIT account, Power Generation Business Unit Grants, and/or Sponsorships as determined by project sponsor. Project cost is estimated at $1500.

Major Deliverables: Location and suitable growing media will be determined for the garden. A moderately-sized garden will be constructed and maintained by volunteers. All produce grown in the garden will be donated to suitable charity organizations.

Acceptance criteria: The project must provide meaningful work for volunteers to use their EEEC hours. The garden will yield enough produce to satisfy supplemental amounts to local charity.

Milestone Schedule:

Delivery of materials	April
Garden construction	April
Garden planting	May

Garden harvesting June through October

Garden decommissioning October

Key Assumptions: The project manager has enough knowledge about gardening to plan accordingly. There will be enough volunteers interested in working on the project. Volunteers are willing to learn and work in the garden. The weather will permit a bountiful yield of fresh produce.

Constraints: The vegetables cannot be planted directly into the existing soil at our facility due to contamination. The garden location must be chosen so as not to interfere with production operations. The garden location must also take into account the existing wildlife that may wish to eat the garden plants (deer, rabbits, mice, etc.).

Major Risks: The garden must be planted early enough in the season for a good yield yet late enough to avoid the average last frost in USDA Zone 5. Poor weather may result in poor yield or total destruction (in 2011 a tornado uprooted several trees on the site). Volunteers will fail to maintain the garden.

Approval Requirements: The project sponsor (Melissa King) will get proper approval from upper management to proceed with the project. The funding will also need to be approved by the Community Involvement Team leader, Kalpana Chilukuri.

Project Manager: Dennis Otremba

Reporting Requirements: None

Authorized By: Melissa King, project sponsor **Date:** March 2, 2015

APPENDIX C

Budget

Budget

The total project budget was $1500. To date the project is under budget. A few things were donated that are not included in the table below: Fence posts, The 150-foot main garden hose, sprinkler timers, tomato cages, and the garden "shed" to store supplies.

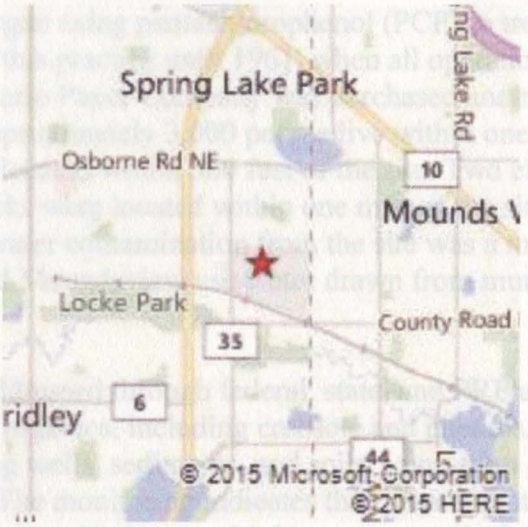
Item	From	Units	Number	Cost/unit	Total
Straw bales	Hertog	bale	100	$5.50	$550.00
Nitrogen Fertilizer	Menards	17# bag	4	$17.95	$71.80
Garden staples	Menards	50pc box	4	$5.99	$23.96
Garden spade	Menards	pc	3	$4.98	$14.94
Landscape fabric	Menards	roll	2	$19.99	$39.98
10-10-10 fertilizer	Menards	10# Bag	2	5.99	$11.98
Tax	Menards				$13.01
Potting soil	Menards	2cft bag	4	$8.98	$35.92
Post driver	Menards	pc	1	$18.88	$18.88
garden hose	Menards	50ft pc	2	$12.99	$25.98
Splitter	Menards	pc	1	$8.97	$8.97
Sprinkler	Menards	pc	4	$9.99	$39.96
Hose acc kit	Menards	pc	1	$2.99	$2.99
Sprinkler spike	Menards	pc	4	$2.99	$11.96
Hose repair	Menards	pc	2	$3.88	$7.76
Carrot seeds	Menards	packet	6	$1.19	$7.14
Beet seeds	Menards	packet	6	$1.19	$7.14
Radish seeds ch	Menards	packet	6	$1.37	$8.22
Bean seeds	Menards	packet	2	$3.95	$7.90
Radish seeds pat.	Menards	packet	1	$1.61	$1.61
Radish seeds ch. G.	Menards	packet	1	$1.49	$1.49
Tax	Menards				$13.25
Potting soil	Menards	2cft bag	3	$8.98	$26.94
Tax	Menards				$1.92
Plants	Smith Farms				$337.00
Total					$1,290.70
Budgeted					$1,500.00
Remaining cash					$209.30

APPENDIX D

EPA Superfund Site Summary

EPA Superfund Site Summary

Boise Cascade/Onan/Medtronics Superfund Site



- Fridley, MN (Anoka County)
- EPA ID# MND006481543
- NPL Factsheet
- Superfund Site Progress Profile
- Alias(es): Old National Pole; Formerly National Pole Treating Co.; Boise Cascade/Onan Corp./Medronics, Inc.; Boise Cascade/Onan Medtronics
- Fridley-Area Superfund Sites

Community Involvement Coordinator
Teresa Jones (jones.teresa@epa.gov)
312-886-0725 or 800-621-8431, ext. 60725
Remedial Project Manager
Bernard Schorle (schorle.bernard@epa.gov)
312-886-4746 or 800-621-8431, ext. 64746

EPA Superfund Home Page
Region 5 Superfund
Superfund Frequent Questions
Agency for Toxic Substances & Disease Registry

Background

The Boise Cascade/Onan/Medtronics site covers 183 acres in Fridley, Minnesota. The National Pole and Treating Company and later the Minnesota and Ontario Paper Company treated wood from 1921 until 1961 at this location. Operations at the site first used creosote to treat wood for railroad ties and utility poles. The company began using pentachlorophenol (PCP) to treat its wood products in 1958 and continued this practice until 1961, when all operations stopped. In 1965, the Minnesota and Ontario Paper Company was purchased and merged into the Boise Cascade Company. Approximately 3,000 people live within one mile of the site. Several residences are located within 500 feet of the site. Two elementary schools and several small urban parks were located within one mile of the site at the time of the investigation. Groundwater contamination from the site was a major concern because the cities of Fridley and Moundsview use water drawn from municipal wells located near the site.

This site was addressed through federal, state, and PRP actions. The EPA detected high levels of organics, including creosote and phenols, in on-site groundwater monitoring wells, sediments, and soils. Long-term groundwater monitoring continues. The monitoring indicates the contaminant plume is decreasing in lateral and vertical extent. No known drinking water wells that are impacted by the contaminant plume.

On the Onan property, the work included: (1) a slurry wall containment system was constructed around the former retort building into which excavated contaminated soil was placed; (2) a cap was constructed over the area surrounded by the slurry wall; (3) dewatering; and (4) treatment of the water prior to discharge. On the Medtronic property, where two wastewater lagoons had been operated, contaminated soils were excavated and disposed of off-site. Groundwater that was in contact and directly beneath contaminated soil was collected, treated, and discharged. About 5,000 gallons of oil was collected and disposed of off-site. For both properties, long-term groundwater monitoring was undertaken. Work was completed in 1986 and the site was deleted from the National Priorities List in early 1995. However, this site has not been delisted from the permanent List of Priorities, or PLP – the state of Minnesota's Superfund list. Ground water monitoring will continue into the future. Brownfield redevelopment at the site will continue to have MPCA oversee remedial activities.

Appendix E

Cummins Core Values: Corporate Responsibility

Cummins Core Values: Corporate Responsibility

The following is a copy of one of the six Cummins Core Values created by the executive team. Each of the three categories are assigned points (1, 3, and 5). By tallying up the points of all the core values (There are six) a manger can objectively score each of their direct reports. By actively recruiting volunteers and recognizing their efforts the project manager for the garden project would score a "1" for this core value.

Core Values Description: Corporate Responsibility
Serve and improve the communities in which we live. Ensure the conduct of the business is a credit to our community. Support company sponsored community projects. Understand how your work can impact the community. Comply with all legal and regulatory requirements.

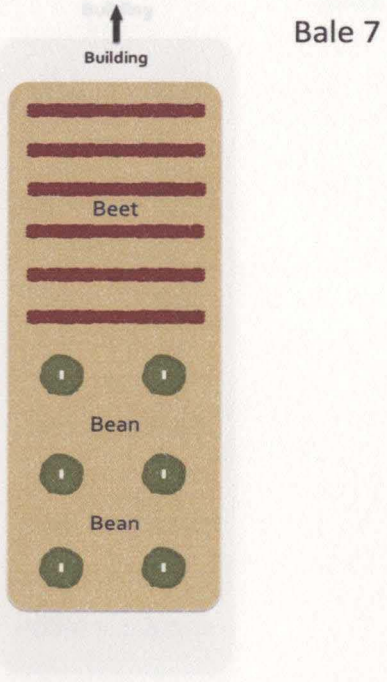
5 **Fails to Meet Expectations**	3 **Meets Expectations**	1 **Exceeds Expectations**
Discourages others from becoming involved in company sponsored community projects.	Personally supports company sponsored community projects. Allows flexibility for others to become involved in company sponsored community projects.	Actively encourages others to become involved in company sponsored community projects. Recognizes the efforts of others on such projects.
Criticized others who are engaged in company sponsored community projects.	Works to understand community issues relevant to their role and the business in general.	Formulates strategies to address community issues relevant to their role and the business in general.
Does not comply with regulations and law related to his/her role.	Fully complies with legal requirements and laws related to his/her role.	Anticipates legal and/or regulatory issues and helps shape proactive initiatives.

APPENDIX F

Detailed Bale Diagrams

Detailed Bale Diagrams

The following bale diagrams were created in MS Visio.

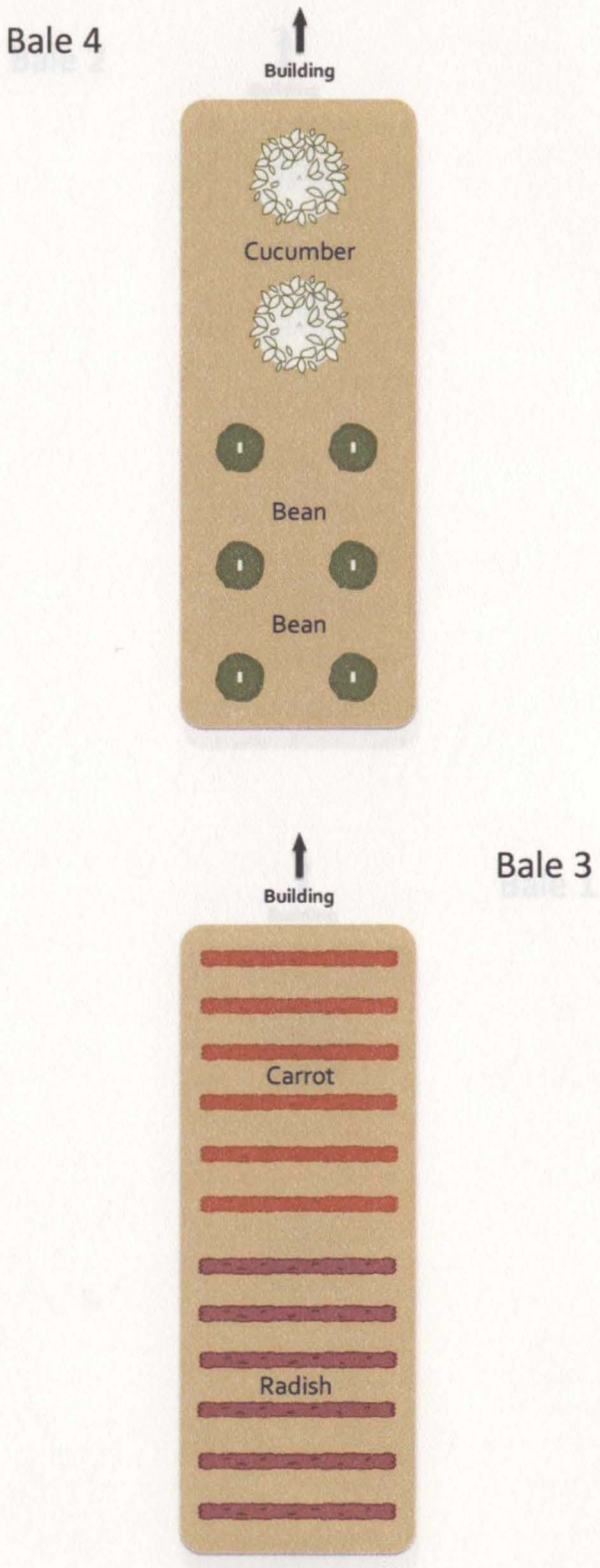


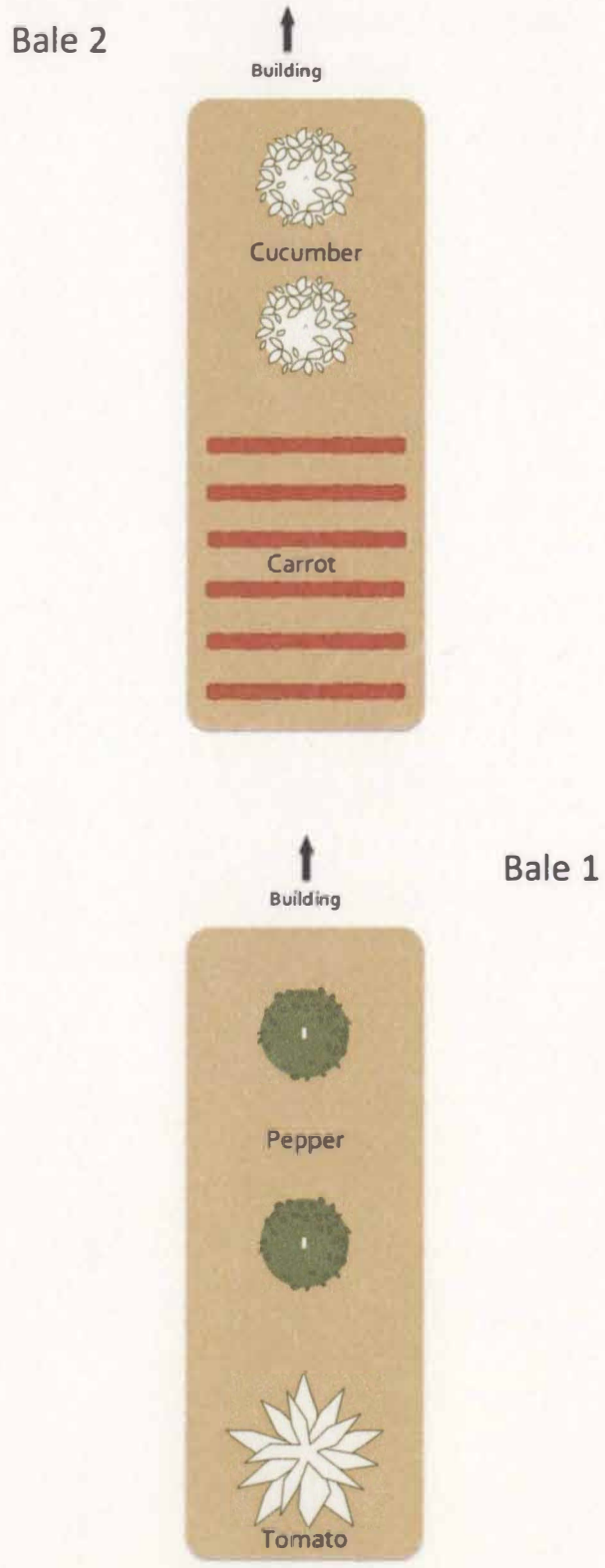
Bale 6


Building
Zucchini
Beet

Bale 5


Building
Kohlrabi
Kohlrabi
Radish


Bale 4
Building
Cucumber
Bean
Bean
Building
Bale 3
Carrot
Radish


Bale 2
Building
Cucumber
Carrot
Building
Bale 1
Pepper
Tomato